Guideline for the Determination of Wetland Buffer Requirements

for public comment
December 2005

Prepared for the Department for Planning and Infrastructure
on behalf of the Western Australian Planning Commission
by Essential Environmental Services

Published by

Western Australian Planning Commission
50 years spatial planning

Albert Facey House
469 Wellington Street
Perth Western Australia 6000

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Published by the
Western Australian Planning Commission
Albert Facey House
469 Wellington Street
Perth Western Australia 6000

Published December 2005

ISBN 0 7309 9535 6

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Acknowledgment

This Guideline has been formulated with the aid of the Wetland Buffers Working Group, chaired by the Department for Planning and Infrastructure (DPI), which provided direction and comments on the format and content of the document. This work has been overseen by the Wetlands Coordinating Committee.

The technical basis for the Guideline was established previously through work undertaken by Welker Environmental Consultancy in the DPI commissioned study Buffering between wetlands and other land uses. This study resulted in two unpublished reports: Study into Buffering Between Wetlands and Other Land Uses: A Management Framework for Wetland Buffering (2002) and Buffering Between Wetlands and Other Land Uses: A Guideline for the Determination of Wetland Buffering Requirements (2003). Text from these reports has been used directly in large parts of this guideline, where explanation of terms and concepts is provided.

Essential Environmental Services acknowledges the significant work of Welker Environmental Consultancy in defining the concepts of buffers, wetland function area, separation distance and separation requirements, including supporting information, diagrams and tables. This information has been used directly to formulate the approach outlined in this Guideline. Essential Environmental Services claims no responsibility for the technical basis of the approach.

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Introduction

This guideline has been developed to assist landowners, developers, planners and architects to identify an appropriate buffer between wetlands and land uses that will enhance or maintain the significant attributes and values of the wetland.

It should be used where a change in land use or development is proposed in the immediate vicinity of a wetland (ie within a lot containing a wetland or adjacent to a wetland) where the future use or development is likely to conflict with the established wetland management objective. This may include urban, some public purposes, intensive rural, commercial or industrial uses and development.

The appropriate separation distance should be identified at an early stage in the planning process so that the proposed plan achieves an acceptable environmental outcome, in the context of planning for sustainability.

This guideline recognises that the planning process must consider other relevant factors, together with environmental factors, in decision-making. Importantly, planning is guided by sustainability principles, as established in the Western Australian State Sustainability Strategy, 2003, that guide strategic actions to meet the 'needs of current and future generations through the integration of environmental protection, social advancement and economic prosperity'.

These guidelines do not apply where landowners are continuing existing activities. However, the principles and approach are supported to establish buffers from existing activities to improve the environmental health and conservation status of a wetland, consistent with its identified management objective.

Buffering of a wetland is recognised as essential for the achievement and maintenance of the wetland's management objective. However, buffering should be considered as only one component of an integrated approach to wetland protection and management. Buffering is proposed as a tool to be employed where separation is appropriate and able to achieve the desired wetland outcomes.

The role that catchment management plays in dealing with wetland issues such as pollution, particularly groundwater pollution, must also be recognised. Groundwater pollution and its impact on wetlands, water regime issues, the terrestrial habitat requirements of many fauna species that inhabit wetlands and the management of mosquitoes and midges extend beyond the influence of wetland buffering. These aspects need to be considered as land planning and management issues in their own right and therefore are beyond the scope of this guideline.

The guideline is structured in seven stages to establish an appropriate buffer between wetlands and existing or proposed development.

Additional information is contained in application notes, which cover the individual stages of the process and help the user complete each step. Guideline application examples, a list of resource documents and a glossary are included as appendices.

The concept of wetland buffers

Buffering provides an important tool in achieving and maintaining the desired values, processes, functions and attributes of wetlands. It involves separating a wetland from the adjacent land use(s) that might threaten its desired values and ensuring wetland activities do not have undue impact on the land use(s), through either spatial separation or the use of physical barriers.

Figure 1 shows the proposed buffering concept in terms of the three basic areas requiring definition to provide separation for the wetland:

- the wetland water body;
- the wetland function area; and
- the separation requirement.

Only permanently inundated wetlands will have a visible area of open water - the wetland water body, all year round. Some wetlands, such as waterlogged areas, never have an open expression of water. Additional information on wetland types is contained in application note 1.

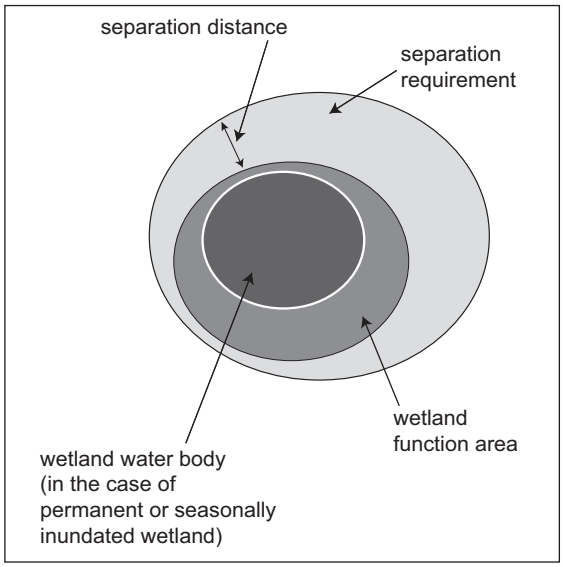

Figure 1 - Generalised wetland buffering concept (Welker Environmental Consultancy, 2002)

The wetland function area is the area which needs to be protected to ensure the important functions and values of the wetland can be maintained. The wetland function area is the spatial boundary of the wetland. It normally would include the wetland itself and the wetland vegetation. The wetland function area is discussed in greater detail in application note 3.

The wetland function area often will require additional separation from surrounding land use(s) to ensure its protection and compatibility with the land use. Separation can involve two general forms: a physical barrier (fence, wall), or a separation distance. These forms are not mutually exclusive, and in some cases, a combination can provide a solution. Key considerations in defining separation needs are values, functions and attributes of the wetland to be protected, the characteristics of the surrounding land use and the threats associated with the land use(s).

A separation distance is generally measured from the boundary of the wetland function area; however, they may be measured from the boundary of the water body in cases of a permanent or seasonally inundated wetland without significant ecological values outside the inundated area.

The separation requirement effectively is the furthest extent of the separation distance required to deal with all separation issues (eg habitat protection, fire management, water quality management) specific to each proposed or existing adjacent land use. Activities compatible with the surrounding land use and the management objective of the wetland can be permitted in all or part of the separation area (eg passive recreation) in accordance with the respective wetland management plan.

Process for determination of wetland buffer

The process to determine an appropriate buffer between a wetland and an existing or proposed land use requires the systematic consideration of wetland attributes (existing or desired), threatening processes associated with adjacent land use, and the role of the buffer in mitigating these threats so the wetland values, functions and attributes are protected to the extent that separation measures can achieve this practically. An individual approach is required to determine buffer requirements, rather than a "one size fits all" approach.

The approach requires completion of a seven step process (figure 2):

- Step 1 Acknowledge existence of wetland
- Step 2 Identify wetland attributes, wetland management category and establish management objective
- Step 3 Define wetland function area
- Step 4 Identify threatening processes
- Step 5 Identify role of separation
- Step 6 Establish separation requirement
- Step 7 Apply separation requirement to proposal and assess its ability to achieve management objective.

The process is depicted in figure 2 and described briefly below. The majority of information is contained in individual application notes at the back of this document, which should be used as necessary to complete each step.

Step 1 Acknowledge existence of wetland

Acknowledgment of the existence of a wetland is the first step in the determination of a wetland buffer. This step does not require any specific definition of the wetland area. The outcome is simply agreement that a wetland of some form exists at a particular location.

Information regarding types of wetlands and existing wetland mapping and identification is contained in application note 1.

Step 2 Identify wetland attributes, wetland management category and establish management objective

A critical step in determining buffering requirements is the identification and definition of the management objective of the wetland.

Wetland evaluation requires an assessment of the values, functions and attributes of the wetland which are used to establish an appropriate management category (application note 2). The information used to establish the management category will aid in the determination of the wetland function area and separation distance, steps 3 and 4 respectively.

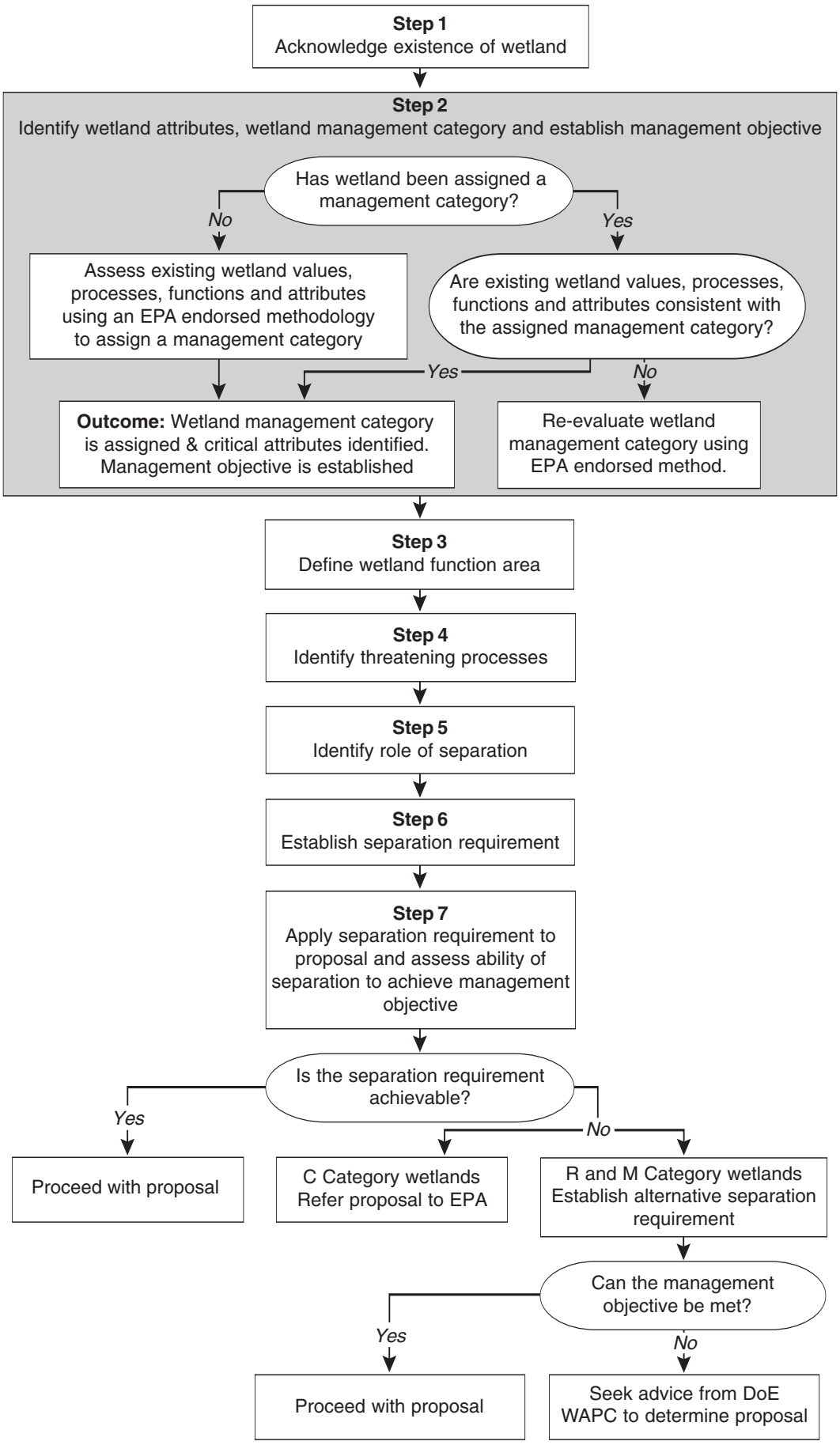

Figure 2 - Proposed process for determination of wetland buffer requirements

Current Swan Coastal Plain evaluation methodologies are used to assign wetlands to one of three management categories:

- C category (conservation): wetlands with high conservation value for both natural or human use;
- R category (resource enhancement): wetlands with moderate natural and human use attributes that can be restored or enhanced; and
- M category (multiple use): wetlands that score poorly on both natural and human use attributes.

Each category has management objective that will ensure retention of the values, functions and attributes associated with the wetland (table 1).

Management objectives have been identified for all wetlands on the Swan Coastal Plain, from Gingin to Dunsborough, through evaluation work completed by the Department of Environment (DoE) (formerly the Water and Rivers Commission) (The Geomorphic Wetlands Swan Coastal Plain dataset can be accessed at www.walis.wa.gov.au). If the wetland in question has already been assigned a management category, the features that have formed the basis for that assignment should be re-evaluated to confirm the management category is appropriate.

If the management category for the wetland is appropriate, the attribute(s) used as the basis for categorisation should be examined to identify the attribute(s) relevant to establishment of the buffer. Table 4 should be used to help determine the key attribute(s) of the wetland and the required function of the buffer. It is important to consider not only the importance of the attribute to achievement of the management objective, but also the degree to which a buffer is able to ensure retention of the attribute.

If the management category is inconsistent with the current state (ie the wetland may be in an improved or more degraded state), the wetland should be re-evaluated using a DoE endorsed protocol and submitted to the DoE for endorsement and update. For further information, see the DoE website http://www.environment.wa.gov.au or contact the Wetlands Program, DoE.

Wetlands yet to be mapped by the DoE will require evaluation with an endorsed protocol, to establish an appropriate management category and objective. Contact the Wetlands Program, DoE for further information and advice or see the above DoE website.

Once a management category has been assigned and the critical wetland attributes – those considered essential to the achievement of the management objective and the effectiveness of the buffer - are identified, proceed to step 3.

Table 1: Wetland management category objectives

Category	Objective
Conservation (C category) wetlands	to preserve wetland (natural) attributes and functions
Resource Enhancement (R category) wetlands	to restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use (M category) wetlands	to use, develop and manage wetlands in the context of water, town and environmental planning

(Source: Hill et al, 1996).

Step 3
Define wetland function area

The wetland function area is the area which needs to be protected to ensure the important functions and values of the wetland can be maintained. It normally would include the wetland, the wetland vegetation and any directly associated dependent terrestrial habitat. If the wetland function area is determined, after a site assessment, to be less than the mapped boundaries, the wetland should be re-evaluated and the results submitted to the DoE so the mapping can be updated.

Information to help define the wetland function area is contained in application note 3. Once the wetland function area has been defined, proceed to Step 4.

Step 4
Identify threatening processes

The key threatening process(es) for the wetland attributes identified in Step 2 should be identified based on consideration of the environmental risks of the various surrounding existing and proposed land uses.

There are many anthropogenic threats to wetlands; however, not all of them may be managed through separation or provision of a buffer. Those that can be mitigated (at least in part) by buffering are:

- alteration to the water regime;
- habitat modification (grazing in wetlands, invasion of exotic species, clearing);
- inappropriate recreational use; and
- diminished water quality (nutrients, organic compounds, suspended solids, toxic compounds and salinity).

Table 6 provides a guideline for the identification of relevant threatening processes associated with the various categories of land use. Once these have been identified relevant to the critical wetland attributes, proceed to Step 5.

Step 5
Identify role of separation

The wetland function area often will require additional separation from surrounding land use to ensure its protection and compatibility with the surrounding land use. Key considerations in defining separation needs are the values, functions and attributes of the wetland and the threats associated with the surrounding land use.

The separation requirement effectively is the furthest extent of separation distances required to deal with all separation issues (eg, habitat protection, fire management, water quality management) specific to each proposed or existing adjacent land use.

It is important to identify the role of the separation requirement for each wetland attribute. This will help to assess the ability of the achievable separation requirement to meet the management objective of the wetland (step 7) and provide the context for any additional separation area management recommendations.

Table 7 should be used to identify the role of the separation requirement in mitigating threatening processes associated with adjacent land use. When the role of the separation with regard to wetland attributes and adjacent land use has been determined, proceed to Step 6.

Step 6
Establish separation requirement

The recommended separation requirements in this guideline are based on consideration of the associated threats and are a factor of the wetland's management category. Different separation measures are required to achieve the different management objectives associated with each management category.

Tables 8, 9 and 10 set out by wetland category, the separation requirement recommended to mitigate the key threatening processes associated with the critical wetland attributes. When the appropriate separation requirement is established, proceed to step 7.

Step 7
Apply separation requirement to proposal and assess ability of separation to achieve management objective

This step involves the overlay of the required separation on the proposal to assess whether it can be achieved. If so, proceed with the proposal.

If the required separation is unachievable, i.e. the recommended separation distance cannot be achieved around the whole wetland function area or the recommended management measures are unable to be implemented, an assessment of what is achievable is required. If it can be demonstrated clearly that the achievable separation (ie separation distance, management measures or a combination of both) will ensure that the appropriate wetland management objective is met, proceed with the proposal.

A reduction in the wetland boundary, the required separation distance or recommended management measures for C category wetlands is unlikely to meet the identified management objective. In such cases the proposal should be referred to the EPA.

A reduction in the recommended separation requirement for R category wetlands, provided it is not associated directly with the critical wetland attributes and additional management measures are proposed to address the reduction, may meet the management objective.

M category wetlands generally are quite degraded and may be weed infested due to their existing use and/or lack of management. The likelihood of having any attributes that require protection through imposition of a buffer is therefore low. Accordingly, it is anticipated that the majority of proposals affecting M category wetlands can be designed and managed to meet the management objective.

Notwithstanding this, the wetland function area or separation distance determined through this process may, in some cases, not be achievable because of existing or planned development within the theoretical buffer area and/or the inability to avoid or adequately manage impacts from adjacent land use. However, modification to either the proposal or the proposed management of the buffer to result in an improved outcome may still meet the wetland's management objective.

The critical wetland attributes and the assigned management category provide the context for decisions on the necessary separation distance and management.

Accordingly, these must be addressed in any argument for reduction of separation requirement. Current technical information should be used in any justification for modified buffering needs.

If, after addressing the management of likely impacts from the proposal, it can be demonstrated that the wetland's management objective can be met, proceed with the proposal.

Where the proposed separation may result in an impact on wetland values, functions or attributes, appropriate approvals may be required to implement the proposal. In these instances, the DoE should be consulted so that an outcome that is acceptable in terms of environmental benefits can be achieved. If it cannot be demonstrated that the wetland values and attributes will be enhanced or maintained, and the proposal cannot be modified to ensure this outcome, particularly where conservation category wetlands are involved, the proposal should be referred to the EPA.

Using the Guideline

The guideline's application notes are designed to facilitate ease of use, as they give the user only the information necessary to complete the appropriate step.

The information obtained from completing each step should be tabulated in a form similar to Table 2, which allows easy identification of critical elements. It establishes a clear process for determining an appropriate separation requirement and allows individual consideration of attributes.

For example, an attribute of a wetland may be the existence of waterbird breeding habitat (step 2). The requirement to maintain this attribute is to retain and protect all areas used by the waterbirds for breeding. This should include areas of open water and seasonal inundation or dampness containing vegetation used by such birds for nesting and shelter.

This requirement can be translated into a boundary requirement (step 3) as, to incorporate this attribute, the wetland function area should extend from the wetland core to include all areas of wetland vegetation possibly utilised by waterbirds. The limit of wetland vegetation therefore defines this boundary. The final wetland function area is determined by incorporating the requirements to maintain all relevant attributes.

The table also can be useful to list the potential threatening processes facing each attribute (step 4) and identify the role of the separation (step 5) using tables 6 and 7.

Table 2: Recommended format for completing steps 3 to 5

Step 2 Attribute	**Requirement to support attribute, for the purpose of defining wetland function area**	**Step 3 Definable boundary/extent**	**Step 4 Threatening processes**	**Step 5 Role of separation**
Migratory bird habitat/breeding ground (protected under JAMBA/CAMBA)	Maintain areas of open water, seasonally inundated areas used for breeding and other areas of vegetation likely to be used by species	Boundary of wetland as mapped by Geomorphic Wetland Database plus surrounding vegetated areas known to be used by birds	• Alteration to the water regime • Habitat modification • Inappropriate recreational use	• Protection from direct disturbance or otherchange/ impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)

(Source: adapted from Welker Environmental Consultancy, 2002).

The appropriate separation requirement then can be established from tables 8, 9 and 10, depending on the management category of the wetland.

It is also useful to summarise the critical points on the summary sheet provided. This form is designed to provide a clear picture of the key stages to help guide the user through the process. It enables the critical information required under one step to be identified and summarised before moving on to the next step.

Unless a significant amount of up-to-date information relating to the wetland is available, the services of a suitably qualified environmental professional are likely to be required to complete this guideline. Assistance may be required to define the wetland function area, particularly the identification of the area/feature required to support and maintain the critical attributes of the wetland. The success of the wetland buffer hinges on the accurate definition of the wetland's boundary.

A field trip should be made to view and take photographs of the wetland itself. The photographs should show clearly the condition of the wetland, all open water, any existing vegetation and evidence of use of the wetland (active or passive recreation or any industrial or rural activities that may impact on the wetland).

The examples in appendices 3, 4 and 5 were completed using desktop information only. This shows that it is possible to determine a buffer with existing information, particularly in the metropolitan region of the Swan Coastal Plain; however it is recommended that a field trip is undertaken to update the field work. This allows confirmation of the management category based on up-to-date information, especially if limited or no management of the wetland has occurred to date.

Wetland Buffer Definition Summary Sheet

Step 1 Location of wetland .....

Step 2 Management category .....

Management objective .....

Critical attributes – high relevance of attribute and high importance to buffering (see Table 4)	Area required to support attribute
.....	.....
.....	.....
.....	.....
.....	.....

Step 3 Greatest extent of wetland function area .....

Step 4 Adjacent land use(s) .....

.....

.....

.....

Threatening processes .....

.....

.....

.....

Step 5 Critical role of separation .....

Step 6 Separation requirement Minimum distance from WFA .....

Management measures .....

Step 7 Is separation requirement achievable? ☐ Yes ☐ No

Application note 1: Acknowledge existence of wetland

1.1 Step 1

Acknowledgment of the existence of a wetland is the first step in the determination of a wetland buffer. This step does not require any specific definition of the wetland area. The outcome is agreement that a wetland of some form exists at a particular location.

1.2 Definition of wetlands

Wetlands are defined as:

> "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". (UNESCO, 1971)

This definition is from the RAMSAR Convention on Wetlands of International Importance (to which Australia is a signatory) and which has been adopted in the Wetlands Conservation Policy for Western Australia (Government of Western Australia, 1997).

Although rivers, creeks, estuaries, caves, and shallow marine areas fall within this definition, their special attributes, values, protection and management requirements fall outside the scope of this guideline and will be addressed primarily through other guidelines or policies.

Wetland types in Western Australia generally are categorised according to Semeniuk (1987), who proposed that wetlands could be classified according to landform (basin, channel, flat, slope, highland) and the longevity with which water is contained (permanently inundated, seasonally inundated, intermittently inundated and seasonally waterlogged). Wetlands may be classified as the following types, as outlined in Table 3. This guideline is not proposed to apply to intermittently inundated wetlands and channel wetlands (as noted above).

The catchment of a wetland can be defined as the area within which any activities undertaken have the potential to affect the water quality or water levels in the wetland function area. However, surface and groundwater catchments should be excluded from specific consideration in determining separation distances.

Table 3: Wetland types (after Semeniuk, 1987)

Water Longevity			**Landform**		
	Basin	**Channel**	**Flat**	**Slope**	**Highland**
Permanently inundated	lake	river	-	-	-
Seasonally inundated	sumpland	creek	floodplain	-	-
Intermittently inundated	playa	wadi	barlkarra	-	-
Seasonally waterlogged	dampland	trough	palusplain	paluslope	palusmont

Information on the presence of wetlands on the Swan Coastal Plain may be obtained from the Geomorphic Wetlands Swan Coastal Plain dataset (DoE). The dataset can be accessed at www.walis.wa.gov.au (the DoE has A Guide to Viewing Wetland Information on the WALIS website), or alternatively, contact the Wetlands Program at the DoE. For information regarding wetlands outside the Swan Coastal Plain, contact the relevant regional office of the DoE.

If it is possible to modify the proposal to exclude the wetland at this stage, it should be done. This action is consistent with the current EPA position which states that "the EPA places great importance on the protection of the remaining wetlands and expects that in the first instance, proponents will conduct a thorough appraisal of all development options, including proper consideration of site selection, that would avoid direct or indirect impacts on wetlands" (EPA, 2001).

Application note 2: Identify wetland attributes, wetland management category and establish management objective

Wetland evaluation is a process used to describe and weigh a wetland's existing and potential values (Hill et al, 1996). It is helpful to be precise in the description of wetland values, characteristics, functions and attributes, so that they are more readily understood and communicated.

2.1 Wetland values, functions and attributes

Wetland characteristics and attributes give rise to environmental values or functions, which in turn may support or protect the beneficial uses of wetlands (EPA, 1999). The following definitions are taken from Claridge (1991) as outlined in Hill et al (1996) with the exception of 'wetland functions' which was adapted from the definition provided in DoE's internet site glossary.

Wetland **values** are a measure or expression of worth placed by society on a particular function, use or attribute.

The **characteristics** are those properties of a wetland which describe the area in the simplest and most objective possible terms (eg wetland size, species present, soil type, water quality). Characteristics, singly or in combination, give rise to benefits (existing or future) which may be functions, uses or attributes of a wetland.

Wetland **functions** are the physical, chemical and biological processes occurring within a wetland.

A **use** is some direct utilisation of one or more of the characteristics of a wetland.

An **attribute** of a wetland is some characteristic or combination of characteristics which is valued by a group within society, but which does not necessarily provide a function or support a use.

Attributes include:

- richness or diversity of flora or fauna;
- landscape/aesthetic qualities;
- value as a cultural, symbolic or spiritual place by a defined group within the community; and
- presence of rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes, processes or wetland types.

For a comprehensive list of characteristics, functions, uses and attributes, see Hill et al, (1996). More attributes are listed in table 4.

Wetland values can be categorised as:

- uniqueness
- naturalness
- habitat or collective attributes
- scientific attributes
- recreational attributes

- aboriginal
- cultural/heritage
- educational

The first three values are natural attributes. The functions of wetlands reflected in those values are considerable and include supporting numerous species of flora and fauna through the provision of breeding and nursery areas, refuge and feeding areas. Representativeness is an additional value that needs to be considered as having importance (Bowen, Froend & O'Neil, 2002).

Human uses of wetlands include the functions of stormwater retention or retardation, numerous forms of recreation, enhancement of urban development through the provision of 'green' corridors. Aboriginal and European heritage uses of wetlands are extensive, including use as a food source and watering points. Educational and scientific study functions also are important human uses.

The Revised Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy and regulations 2004, (EPA, 2004) proposes that wetlands with at least one significant natural attribute or at least two environmental values listed in the regulations are worthy of registration for protection under the draft Environmental Protection Policy.

2.2 Wetland management categories

A wetland management category system was established by the EPA (1993b) in Bulletin 686. This is the system currently endorsed by the EPA; however, current practices tend to use the system outlined in Hill et al (1996). Accordingly, Bulletin 686 is under review.

Hill et al proposes three wetland management categories:

- C category (conservation): wetlands with high conservation value for both natural or human use;
- R category (resource enhancement): wetlands with moderate natural and human use attributes that can be restored or enhanced; and
- M category (multiple use): wetlands that score poorly on both natural and human use attributes.

The review of Bulletin 686 is not expected to result in any change to the current management categories as it is purported to result in the amalgamation into one document of the range of methodologies already used.

Wetlands are scored against a suite of attributes (currently under revision by DoE) to determine their management category. Given the current revision of the attributes to be used and the scoring process, the information contained in this guideline is based on an expectation of the general outcome of the revised categorisation system.

A management objective has been identified for all wetlands on the Swan Coastal Plain through evaluation work completed by the DoE. For further information regarding wetland classification, evaluation and mapping see the DoE website http://www.environmental.wa.gov.au or consult the DoE Wetlands Program.

2.3 Step 2

In this step, the outcome is the assignment of a management category to the wetland with its associated management objective. This step also requires the identification of attributes considered to be critical to the wetland, the assignment of a management category and the effectiveness of the buffer.

2.3.1 Determination of management category and objective

If the management category for the wetland has been previously determined (as is the case for all wetlands on the Swan Coastal Plain from Gingin to Dunsborough), the attributes used as the basis for categorisation should be re-examined to ensure that they remain consistent with the assigned management category. The Geomorphic Wetlands Swan Coastal Plain dataset can be accessed at www.walis.wa.gov.au.

If there is any inconsistency between the management category and the current state of the wetland, a re-evaluation by the landowner is necessary. Application to the DoE Wetlands Program should be made to obtain the current re-evaluation protocol. As this guideline uses management categories as a basis for the final recommendations, the re-evaluation of the wetland should be completed by the land owner and endorsed by the DoE before progressing to step 3.

Further information is available on the DoE website http://www.environment.wa.gov.au.

If the management category has not been determined, there is a need for the landowner to assess the existing wetland values, processes, functions and attributes and assign a management category for the purpose of establishing the buffer measures. To categorise an unassessed wetland, an evaluation should be made by an appropriately qualified person using an EPA endorsed methodology. This step could involve either the two-tier method of evaluation described in chapter 5 of Hill et al (1996) or the Semeniuk evaluation method. These two methods currently are being combined into one evaluation methodology, which will form an update to Bulletin 686 (EPA, 1993b).

Each management category has an objective for management that will ensure retention of the attributes associated with the wetland (table 1).

Once the management category has been assigned, the appropriate objective can be allocated.

2.3.2 Identification of critical wetland attributes

Once the management category for the wetland has been established, the attributes used as the basis for categorisation should be examined to understand those relevant to buffering. Not

Table 1: Wetland management category objectives (repeated)

Category	Objective
Conservation (C category) wetlands	to preserve wetland (natural) attributes and functions
Resource Enhancement (R category) wetlands	to restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use (M category) wetlands	to use, develop and manage wetlands in the context of water, town and environmental planning

(Source: Hill et al, 1996).

all attributes can be protected through wetland buffers. Therefore, those most relevant to buffers and to the establishment of the management category should be identified – the critical attributes.

Table 4 sets out the relative importance of wetland attributes to achievement and protection of the management objective for the wetland category and provides a general description of the role of the wetland function area and the separation area. As with a buffer distance, a degree of individual judgment is involved in determining relative importance and table 4 is intended as a guide only. Additionally, the table is not comprehensive, as it would be impossible to list all the attributes that may be ascribed to wetlands in WA. Accordingly, case-specific considerations are necessary and may result in some modification to the outcomes.

Additional considerations:

- If already categorised, determine the features that have given the wetland its management category. Some information is provided in Hill et al (1996); however, some of this information is now out of date and therefore mapping in the Geomorphic Wetlands Swan Coastal Plain Dataset also should be referred to. If the wetland is recognised in System 6, the Directory of Important Wetlands in Australia, the Register of the National Estate, the Perth - Bunbury Water Resources Allocation Plan or Busselton – Walpole water resources studies, the values will be discussed in these reports.
- If applicable, determine the justification for the wetland being protected by policy, such as listing under an environmental protection policy or Bush Forever, or convention such as RAMSAR. The justification for the listing of the wetland would provide information on the most significant ecological values previously identified for that wetland.
- If the wetland is contained within an area under conservation management such as in a CALM-managed conservation reserve and/or regional park, values and attributes of the wetland may be listed in the management objectives for such areas. Management plans often exist for these areas, particularly in the case of regional parks, and should be reviewed for information relating to the values of the wetland in question in addition to listed wetlands ecological processes that the park or reserve is intended to maintain.

Additionally, the wetland values and functions could be assessed by reviewing existing studies or conducting new studies on the wetland to investigate the presence of attributes (table 4).

Studies that would contribute important information include those investigating:

- vegetation and flora within and surrounding the wetland to determine the presence (attribute) of significant conservation (value) species or communities (maintenance of these would be functions of the wetland);
- fauna, in or associated with the wetland, to determine the presence (attribute) of fauna, their conservation significance (value) and how the wetland is used by this species ie habitat, food resource (these would be functions of the wetland);
- vegetative and surface hydrological linkage to other wetlands and areas of remnant vegetation;
- water quality of wetland and comparison with Australian and New Zealand Environment and Conservation Commission guidelines for the maintenance of aquatic ecosystems (2000);

- its relationship to groundwater hydrology (ie recharge, discharge) and surface hydrology (eg filtering zone before river/estuary), which would be specific functions of the wetland;
- Aboriginal heritage / ethnographic value;
- its social significance through surveys of recreational and commercial use, perception in community, and determination of proximity to various land uses, particularly residential areas; and
- other key attributes in the evaluation methods.

It is acknowledged that unless a significant amount of up-to-date information relating to the wetland in question is available, it is likely that the services of a suitably qualified environmental professional will be required to complete this step. Assistance may be required to undertake the above studies. These studies are important, as they provide current information to accurately identify wetland attributes and corresponding wetland boundaries. The information also would ensure the attributes identified were specific to the particular wetland, rather than being identified generally from a table or book.

Table 4: Relative importance of wetland attributes to achievement of management aims

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Ecological	Presence of rare, endangered, restricted, endemic or vulnerable species and/or communities	H	M	L	H	• Provides the habitat and ecological context for the species and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function areas • Can provide indirect support for wetland function areas through hydrological and terrestrial processes (eg external origin of resources)
	Ecological or geological features of national or international significance	M	M	M	M	• Provides a context for the ecological or geological feature and maintains ecological processes and biodiversity essential for integrity and resilience • Provides a geological context for the formation and/or resource	• Protection from direct disturbance or other change/impact to the wetland function areas • Can provide indirect support for wetland function areas through hydrological and terrestrial processes (eg external origin of resources)
	Constitute part of a linked natural system such as destruction would disturb adjacent wetlands or fauna using the system	M	M	M	H	• Can link adjacent wetland function areas • Provides an ecological context for the species, habitat and/or resource, and maintains ecological processes and biodiversity essential for integrity and resilience	• Can link adjacent wetland Separation Areas. Protection from direct disturbance or other change/impact to the WFA. Can provide indirect support for WFA) through hydrological and terrestrial processes (e.g. external origin of resources)
	Supports high habitat diversity	H	M	L	H	• Provides an ecological context for the habitat and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function areas • Can provide indirect support for wetland function areas through hydrological and terrestrial processes (eg external origin of resources)
	Habitat of plants or animals at critical stage of biological cycle or vulnerable stage of their life cycle	M	M	L	H	• Provides an ecological context for the habitat and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)

[1] Relative importance of attribute relative to achievement of management category aims
[2] H, M, L: high, medium, low relative importance
[3] IOB: importance of buffering - Relative importance of buffering to achieving/protecting the attribute
[4] management category C: High conservation value
[5] management category R: Resource enhancement
[6] management category M: Multiple use

Table 4: Relative importance of wetland attributes to achievement of management aims (continued)

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Ecological	Important for maintaining species and/or ecological diversity	H	M	L	H	• Provides an ecological context for diversity and maintains ecological processes and biodiversity essential for maintaining that diversity	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Important regional wildlife sanctuary even if flora/ fauna are not rare or endangered	M	H	L	H	• Provides an ecological context for the species, habitat and/or resource, and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Supports large numbers of fauna/flora or 1% of national population	M	M	L	M	• Provides an ecological context for the species, habitat and/or resource, and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Seasonal or temporary habitat or breeding ground of large numbers of migratory birds or nomadic animals	M	M	L	M	• Provides an ecological context for the species, habitat and/or resource, and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Supports extensive areas of emergent and fringing wetland vegetation	H	M	L	M	• Provides an ecological context for the species, habitat and/or resource, and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)

[1] Relative importance of attribute relative to achievement of management category aims
[2] H, M, L: high, medium, low relative importance
[3] IOB: importance of buffering - Relative importance of buffering to achieving/protecting the attribute
[4] management category C: High conservation value
[5] management category R: Resource enhancement
[6] management category M: Multiple use

Table 4: Relative importance of wetland attributes to achievement of management aims (continued)

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Ecological	Water quantity and quality	H	M	H-L	M	• Provides an ecological context for the physicochemical processes that occur within it • Maintenance of biological and physical processes critical to wetland water quality	• Vegetation interception and use of nutrients in surface and subsurface flow • Can suppress water tables locally and reduce salinisation of surface soils • Role highly dependent on hydrogeology and catchment characteristics
	Drainage (to and from) and presence of nutrient sources	H	M	L	M	• Acts as a discharge site during wet periods and possibly as a recharge site during dry periods • Provides an ecological context for the physicochemical processes that occur within it • Maintenance of biological and physical processes critical to wetland water quality	• Vegetation interception and use of water in surface and subsurface flow • Can suppress water tables locally • Role highly dependent on hydrogeology and catchment characteristics • Role redundant where channelised (piped) discharge into wetland occurs
	Supports significant proportion of indigenous fish, food source, spawning ground, nursery or migration path	M	M	L	M	• Provides an ecological context for the species, habitat and/or resource and maintains ecological processes and biodiversity essential for integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
Other criteria*	Representative example of wetland type, biogeographical region, function/ role in river or coastal system or major wetland system/ complex	M	M	L	M	• Maintenance of unique/representative character and/or function • Provides an ecological context for the attributes and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Rare or unusual wetland within a region	H	M	L	M	• Maintenance of unique/representative character and/or function • Provides an ecological context for the attributes and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)

Table 4: Relative importance of wetland attributes to achievement of management aims (continued)

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Other criteria*	Australian heritage commission criteria – important for natural or cultural history (4 separate criteria)	H	M	L	M	• Maintenance of unique/representative character and/or function • Provides an ecological context for the attributes and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Unaltered or unusual wetland vegetation, fauna or processes	H	M	L	H	• Maintenance of pristine condition • Provides an ecological context for the condition and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
	Important to maintain the quality of human or animal and plant life eg vegetation to arrest soil erosion	M	H	H	M	• Maintenance of unique/representative character and/or function • Provides an ecological context for the attributes and maintains ecological processes and biodiversity essential for wetland integrity and resilience	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
Human use	Aesthetics	H	H	M	H-M	• Maintenance of aesthetic qualities • Provides an ecological context for the qualities and maintains ecological processes and biodiversity essential for wetland aesthetics	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area
	Wilderness function	H	L	L	H	• Maintenance of wilderness features, function (as for pristine) and social/cultural importance • Provides an ecological context for attributes and maintains ecological processes and biodiversity essential for maintaining wilderness condition	• For maintenance of wilderness function, separation should extend to wetland catchment boundary • Is an integral part of the surrounding wilderness • Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)

Table 4: Relative importance of wetland attributes to achievement of management aims (continued)

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Human use	Historical, archaeological or cultural significance	H-L	H-L	M-L	M	• Provides an environmental context for the features and cultural values and maintains ecological processes and biodiversity essential for maintaining wetland condition	• Can add to as well as maintain features of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area • Protection of wetland features and function integral to cultural values • Protection from direct disturbance or other change/impact to the wetland function area
	Passive recreation	M	H	H-L	M	• Provides a focus for passive recreation. Maintenance of recreation features • Provides an environmental context for recreation attributes and maintains ecological processes and biodiversity essential for maintaining wetland condition	• May be a focus for passive recreation. Protection of wetland features and function integral to recreation values. Protection from direct disturbance or other change/impact to the WFA
	Active recreation	L	M-L	H-L	L	• Provides a focus for passive recreation • Maintenance of recreation features • Provides an environmental context for recreation attributes and maintains ecological processes and biodiversity essential for maintaining wetland condition	• May be a focus for passive recreation • Protection of wetland features and function integral to recreation values. Protection from direct disturbance or other change/impact to the wetland function area
	Effect on land values	L	M	H-L	M-L	• Maintenance of aesthetic qualities • Provides an ecological context for the qualities and maintains ecological processes and biodiversity essential for wetland aesthetics	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area

[1] Relative importance of attribute relative to achievement of management category aims
[2] H, M, L: high, medium, low relative importance
[3] IOB: importance of buffering - Relative importance of buffering to achieving/protecting the attribute
[4] management category C: High conservation value
[5] management category R: Resource enhancement
[6] management category M: Multiple use

Table 4: Relative importance of wetland attributes to achievement of management aims (continued)

	Attribute	Relevance of attribute[1] (H, M, L)[2]			IOB[3] (H, M, L)	Role of wetland function area	Role of separation
		C[4]	R[5]	M[6]			
Human use	Research resource/scientific importance	H	H	H	M	• Maintenance of unique/representative character and/or function of research interest	• May be of research interest • Protection from direct disturbance or other change/impact to the wetland function area
	Educational significance	H	H	H	M-L	• Maintenance of unique/representative character and/or function of educational interest	• May be of educational interest • Protection from direct disturbance or other change/impact to the wetland function area
	Important productive area for commercial endeavours, eg fisheries	L	M	H	H-M	• Maintenance of wetland features, function and commercial (direct or indirect) importance • Provides an ecological context for attributes and maintains ecological processes and biodiversity essential for maintaining production values	• Protection from direct disturbance or other change/impact to the wetland function area

Cannot be defined by one attribute

(Source: Welker Environmental Consultancy, 2002)

[1] Relative importance of attribute relative to achievement of management category aims
[2] H, M, L: high, medium, low relative importance
[3] IOB: importance of buffering - Relative importance of buffering to achieving/protecting the attribute
[4] management category C: High conservation value
[5] management category R: Resource enhancement
[6] management category M: Multiple use

Application note 3: Define wetland function area

The wetland function area means the area required to be protected to ensure the important values, processes, functions and attributes of the wetland can be maintained. The wetland function area normally would include the wetland itself, the wetland vegetation and any directly associated dependent terrestrial habitat.

The wetland function area often will require additional separation from surrounding land use to ensure its protection and to ensure compatibility with the surrounding land use. Separation can be achieved via a physical barrier (fence, wall, etc.) or by a separation distance. These forms of separation are not mutually exclusive, and in some cases, a combination can provide a solution.

The wetland function area will typically include, in addition to any open water, all wetland vegetation unless the management objective is such that the peripheral wetland vegetation need not be retained or considered.

For example, a small lake within grassed parkland may be classified for multiple use, where the only important wetland value is to support an area of open water. In this case, the wetland function area could be restricted to the high-water mark and would not extend to the grassed parkland.

Definition of the high-water mark is somewhat problematic and such boundaries should be considered on a case-by-case basis. Use of the highest historical water level is not a specifically defined level as it may depend on several factors, not the least being the amount of recorded water level data available.

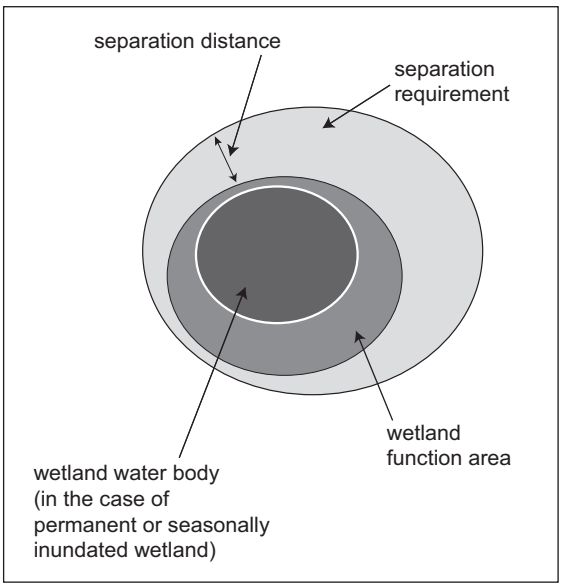

Figure 1 - Generalised wetland buffering concept (Welker Environmental Consultancy, 2002) (repeated)

However, use of historical data is recommended to ensure that the current environmental conditions, such as lack of rainfall, have not led to an uncharacteristic wetland state.

It is proposed that the wetland function area be defined by the outer boundary of the wetland vegetation or the geomorphologic boundary, whichever is the larger, unless a specific case can justify extension beyond that boundary. Extension of the wetland function area to surrounding upland vegetation areas would not normally occur unless those areas served a specific role in maintaining wetland processes and contain or serve attributes associated with the wetland, consistent with the management objective. The issue of protection of terrestrial fauna habitat that is remote from the wetland (even when the primary habitat is within the wetland function area) extends beyond the capacity of wetland buffers.

There is therefore a need to consider those species and their habitat needs through a separate environmental assessment process.

This is consistent with the mapping of wetlands undertaken to date by the DoE contained in the Geomorphic Wetland swan Coastal Plain Databset and should be used where available. All wetlands of the Swan Coastal Plain from Moore River to Dunsborough have been mapped, evaluated and classified and a framework is being developed for wetlands in the remainder of the State. If a wetland has not been mapped and included on the dataset, advice should be sought from the DoE Wetlands Program on the approach to be used to determine the wetland boundary. The Geomorphic Wetlands Swan Coastal Plain dataset can be accessed at www.walis.wa.gov.au.

The issue of protection of upland habitat needs to be considered as a separate (although associated) matter beyond the scope of wetland buffering. Notwithstanding this, separation can be expected, at least in part, to provide some protection for upland habitat.

3.1 Step 3

This step initially involves the assessment of the material used to evaluate the wetland in terms of its management category to define the boundary of the wetland function area. The wetland function area is the area required to be protected to ensure the important values, processes, functions and attributes of the wetland can be maintained.

For each attribute, the requirement to maintain or retain that attribute should be identified and then, where possible, related to a definable boundary centred on the wetland. It can be useful to tabulate the requirements to support significant attributes to determine the wetland function area (table 5).

The use of a table at this stage of the process allows the identification of the requirements to support the listed attributes of the wetland, together with an estimation of the area applicable to this requirement. The latter is defined by a boundary around the wetland, which differs in its extent away from the wetland core according to the attribute being maintained by it.

It is possible that some of these boundaries will be defined by the interface between an area of bushland and another land use that serves no role in supporting the particular attribute of the wetland, such as a residential or industrial area containing no native vegetation. This is highly likely in the case of wetlands in well-established urban areas, such as Yangebup Lake, where residential and industrial areas have been established close to conservation wetlands. It should be noted, however, that small roads (two lanes) separating bushland are considered by the DoE not to interrupt the wetland function area.

Where practicable, the wetland function area is defined as the area within the maximum extent of these boundaries. That is, if all boundaries were to be presented as an overlay on an aerial photograph of the wetland (the approach that is recommended in practice), the wetland function area is the envelope incorporating all the boundaries. For example, an important attribute of a wetland may be the existence of waterbird breeding habitat. A requirement to maintain this attribute is to retain and protect all areas used by the waterbirds for breeding, which would include areas of open water and seasonal inundation or dampness containing vegetation utilised by such birds for nesting

and shelter. This requirement can be translated into a boundary definition as, to incorporate this attribute, the wetland function area should extend from the wetland core to include all areas of wetland vegetation possibly used by waterbirds. The limit of wetland vegetation therefore defines this boundary. The final wetland function area identified is the result of incorporating the requirements to maintain all relevant attributes.

It should be noted that if the final wetland function area boundary is less than that mapped in the geomorphic wetlands datatset, DoE will not alter the dataset unless it is demonstrated that the mapped boundary is not consistent with the true wetland boundary. For more information see the Draft Protocol for proposing modifications to geomorphic wetlands datatset.

Once the wetland function area has been identified, proceed to Step 4.

Note: A table can be useful in listing the potential threatening processes facing each attribute and identifying the role of a separation requirement using tables 6 and 7 as a guide. A table of the attributes of the Coogee Springs wetland is presented as an example in Table 5.

Table 5: Defining the wetland function area for each attribute

Attribute	Requirement to support attribute, for the purpose of defining wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Part of significant regional wetland system	Maintain wetland area	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset held by DoE	• Alteration to the water regime • Habitat modification	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Remnant wetland fringing vegetation	Maintain areas containing emergent wetland species	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset held by DoE	• Alteration to the water regime • Habitat modification • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)

Table 5 continued next page

Table 5: Defining the wetland function area for each attribute (continued)

Attribute	Requirement to support attribute, for the purpose of defining wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Supports large range of macroinverte-brate fauna	Maintain natural water levels. Protect fringing Melaleucas that are within seasonally inundated zone	Areas permanently or seasonally inundated	• Alteration to the water regime • Habitat modification • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Waterbird breeding habitat	Maintain natural water levels. Protect fringing wetland vegetation	Areas permanently or seasonally inundated and containing wetland vegetation	• Alteration to the water regime • Habitat modification	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Potentially provides habitat and/or refuge for a range of frogs, reptiles, birds, and mammals, not otherwise present (associated fauna)	Maintain all areas on which associated fauna are dependent, such that local representation is not affected	Extending from wetland to average known extent of foraging/ use of associated fauna	• Alteration to the water regime • Habitat modification • Inappropriate recreational use • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Visual amenity of open water	Maintain seasonal water levels	Areas seasonally inundated	• Alteration to the water regime	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to wetland function area

(Source: Welker Environmental Consultancy, 2002)

Application note 4: Identify threatening processes

The key threatening process(s) should be identified, based on consideration of the environmental risks of the various surrounding land uses. These threatening processes should also be associated with the wetland attributes identified in Step 2.

4.1 Threats to wetlands

There are many anthropogenic threats to wetlands; however, not all of them may be managed through separation or provision of a buffer. Those that can be mitigated (at least in part) by buffering are:

- alteration to the water regime;
- habitat modification (eg grazing in wetlands, invasion of exotic species, clearing);
- inappropriate recreational use; and
- diminished water quality (nutrients, organic compounds, suspended solids, toxic compounds and salinity).

These threats are discussed in more detail in the following sections and summarised in table 6. For a comprehensive list of anthropogenic threats to wetlands, see Bowen, Froend & O'Neil (2002).

4.1.1 Alterations to the water regime

All wetland processes are maintained by the associated water regimes and any alteration to the regime will result in changes to the flora and fauna.

Water regimes can be changed through several means. Those relevant to wetland buffering include:

- removal of vegetation (affects the water balance through reduced interception and transpiration);
- development of impervious surfaces (increases water interception, but may increase groundwater recharge if concentrated and directed to sumps); and
- directing drains or diverting natural creeks into or away from wetlands.

Wildlife impacts of changing water levels include loss of nesting sites and food sources, lowered biodiversity and emergence of exotic predators.

Groundwater pumping clearly can influence wetland water-level regimes but is not dealt with here as buffering is an inappropriate management response to deal with this effect.

Rises in water level cause deaths to fringing vegetation (which may relocate to a higher elevation if it occurs slowly) and an increase in habitat suitable to aquatic flora and fauna. This impact usually is caused by activities in the catchment and buffering again is an inappropriate management measure to control this. Removal of large areas of vegetation close to the wetland can be managed, at least in part, through inclusion of susceptible areas in a buffering space.

Buffering can assist management of these impacts through constraints on removal or damage to vegetation close to the wetland function area, control of land development close to the wetland function area that will

have a significant influence on vertical water fluxes, and management or elimination of drains discharging into wetlands. Provision of a separation with appropriate controls is the primary buffering mechanism.

4.1.2 Habitat modification

The primary modification of wetland habitat occurs through the removal of vegetation. This includes wetland and upland vegetation. Removal can be direct, through clearing, or indirect, through means such as fire, which also may result in loss of native seeders and sprouters.

Grazing in wetlands and associated upland vegetation creates a threat when, for example, certain native species are excluded or inappropriate native species are introduced, or when feral animals or stock graze in wetlands. The impacts are loss of habitat (eg, preferred food species, shelter, roosting areas), competition with native animal food sources, and physical damage to vegetation.

Management measures include:

- fencing to prevent stock and feral animals entering the wetland;
- providing alternative watering points;
- controlling stock densities; and
- culling feral animal populations.

The invasion of wetlands by exotic species typically occurs after wetlands and associated upland vegetation are disturbed or degraded. Exotic plant species can smother or inhibit native vegetation, alter organic matter fluxes, inhibit light penetration (shading out benthic plants), interfere with water movement, change evapotranspiration, alter water quality and create fire hazards. Nearby residential and agricultural areas are a particular source of weeds and exotic plants that can create a risk of invasion of wetland areas.

Exotic animals can compete with and prey on native species. Species such as carp can increase turbidity, reduce invertebrate numbers and cause declines in numbers of fish and wetland plants.

Buffering can help manage these impacts though constraints on removal or damage to vegetation, fencing, and controlling exotic animal populations.

4.1.3 Inappropriate recreational use

The ability to use wetlands is considered one of the most important attributes of wetlands by the general community. Recreational use may be active, such as water skiing, swimming or horse riding, or passive, such as bird watching, picnicking or research. Use of wetlands by the community, however, sometimes results in impacts on the wetland that are detrimental to its values.

Recreation impacts on wetlands and associated upland vegetation include trampling of vegetation, bank erosion, pollution and disturbance of wildlife. Buffers, particularly physical barriers, are an effective way of managing many impacts from inappropriate use in urban and rural areas. Appropriate management of recreational usage such as through fencing, regulation, signage (education) and provision of vegetated areas which enhance degraded wetlands and encourage people to use them instead of high conservation wetland areas, are relatively simple ways of minimising or eliminating this type of impact on wetlands.

The appropriateness of use of wetlands largely is a function of the management

category of the wetland. It is unlikely that active recreational pursuits are appropriate in C category wetlands, where they may be acceptable in R and M category wetlands. For guidance on appropriate use of wetlands, refer to the relevant wetland management plan, CALM or the DoE Wetlands Program.

4.1.4 Water quality

Pollution affects the full range of wetland ecosystem processes. Bunn et al (1997) categorised pollutants as:

1. Nutrients – nutrient enrichment is a widespread occurrence in wetlands resulting in algal blooms that affect productivity, create odours, spoil water taste and appearance and can produce toxins (that can affect wetland biota or drinking water supply quality). Effects on wetland biota can result in a change in species structure and diversity (both flora and fauna).

2. Suspended solids and sedimentation – excessive amounts of sediment entering wetlands can cause detrimental effects on plant and animal (vertebrate and invertebrate) communities through a gradual infilling of the wetland, smothering of flora and fauna and reduction of light transmission through the water column. This may occur as a result of land clearing adjacent to wetlands that leaves areas of bare soil that are transferred to the wetland by wind and surface water flow.

3. Organic compounds – organic wastes from household effluent, animal wastes and urban runoff can foul water, build up in the food chain, cause odours and increase biological oxygen demand. Many organic compounds (eg hydrocarbons, detergents) can be irritants or toxic to fish and possibly to invertebrates.

4. Toxic compounds – wetlands act as sinks for many pesticides and other chemicals used in wetland catchments. Pesticides and heavy metals form the main toxic materials of concern. Degradation of wetlands can affect water chemistry (pH, chelating agents, etc) and enhance the toxicity of heavy metals. The presence of toxic material in wetlands is likely to be long term and chronic and where the material may not directly kill flora and fauna, it can make it more susceptible to other environmental stresses such as salinity. High concentrations of toxicants may also induce acute toxic effects, including flora and fauna death. Metal poisoning can cause large algal growths though removal of algal grazers and competitive algae.

5. Salinity – secondary salinisation where a wetland becomes unnaturally saline, primarily due to vegetation clearing. Salinisation may also occur from mining or industry discharges. Most biota have limits to the salinity they can tolerate and salinity impacts on wetlands usually involve a change to more salt tolerant species.

The phenomenon of acidification of wetland water bodies through occasional drying and oxidation of sediments has been observed recently in several locations. Lake Gnangara is a recent example. Land clearing and artificial lowering of water tables in susceptible areas also may induce acidification of surface and groundwater entering wetlands. For further information, refer to Planning Bulletin 64 Acid Sulfate Soils (WAPC, 2003) or the DoE Acid Sulfate Soils Guidelines Series at www.environment.wa.gov.au/contaminatedsites

The primary role of buffering in managing water quality is through management or elimination of drains carrying pollutants discharging directly into wetlands or their buffers. It also is important to eliminate treatment basins which may contaminate the groundwater of the wetland or overflow into the wetland.

Buffering incorporating the use of biological filters should be considered; however, this can be expected to play a significant role only with surface water inflows. Groundwater inflows are more problematic, particularly in areas such as the Swan Coastal Plain where the ability of wetland fringing vegetation to take up nutrients before they enter wetlands via the groundwater through-flow will be limited.

Apart from minimising drainage discharges directly into wetlands, the most effective means of managing wetland water quality is through catchment management processes rather than buffering.

4.2 Environmental risk of various land uses

Different land uses generate different threats to wetlands. While specific land use development proposals need to be evaluated on a case-by-case basis, the following general risks apply to the various major land use categories.

4.2.1 Rural land uses

Rural land uses fall into two broad categories: broad acre farming and intensive agricultural industries. Both constitute risks to wetlands.

Land clearing is the primary threat common to both categories. Broadacre farming introduces exotic animals and plants and presents risks from predation and overgrazing. Use of pesticides and fertilisers are risks common to most agricultural uses, independent of intensity.

Intensive agricultural industries such as horticulture and animal feedlots present these risks in a substantial form. Piggeries are a particular intensive agricultural pursuit unsuited to being close to wetlands because of the high nutrient outputs. Stock trampling and overgrazing of understorey are common occurrences.

Salinity effects on wetland areas are the result of land clearing to support broadacre farming. Land clearing also causes rises in groundwater and associated wetland water levels, resulting in drowning of fringing vegetation.

Special rural land use zonings create some risks as a range of activities can be carried out on rural lifestyle properties, many of which may in effect be light industrial rather than agricultural. Activities such as vehicle and machinery maintenance create similar risks to light industrial activities through input of organic and inorganic pollutants and nutrients. The proximity of rural lifestyle properties can generate opportunities for inappropriate recreation, including horse-riding trails.

Groundwater abstractions to supply irrigation water for intensive horticulture can be a major influence on wetland water levels. Buffering is an inappropriate measure to control groundwater abstractions, however, bores should not be permitted within the wetland function area or separation area if likely to affect wetland water levels. This issue is best addressed by controlling groundwater abstractions to

ensure drawdown impacts on wetlands are within appropriate limits.

Artificial maintenance of wetland levels through the addition of water to the water body is undertaken for several wetlands on the Swan Coastal Plain and is an effective management measure in specific circumstances.

4.2.2 Urban land uses

Urban land uses include residential, special residential, and light and heavy industry.

Apart from clearing pressures resulting from commercial opportunities from all forms of land development in urban areas, residential land uses generate pressure on wetlands through the potential for inappropriate recreation, traffic noise, weed infestation, drainage and stormwater run-off, pollutant discharges and groundwater impacts of contamination and abstractions.

There are numerous examples of development of residential land increasing groundwater recharge and permanently raising water levels, resulting in drowned fringing vegetation. This occurs through the combined effect of clearing native vegetation and the creation of impervious areas that direct stormwater to sumps which increases the overall infiltration rate to groundwater from storm events. Examples of wetlands with drowned vegetation in the Perth metropolitan area are Lake Claremont and Blue Gum Lake.

Eutrophication of wetlands occurs through drainage carrying lawn and garden fertilisers into the water bodies. Organic material in lawn clippings is a particular issue with residential areas.

Industrial areas carry the risks of noise and water quality impacts through drainage discharges and groundwater contamination.

The aesthetic aspects of urban wetlands create pressures on water managers to maintain permanent water in ephemeral wetlands. Periodic drying of wetlands is recognised as being necessary to maintain wetland health and reductions in the range of water variation can cause water quality problems and other problems.

As in rural areas, groundwater abstractions in urban areas create risks to wetlands and again are better managed through controls on abstractions rather than buffering.

4.2.3 Other land uses

Other more specific land uses create a variety of risks. Clearly, reserves that prevent land clearing and intensive activities are generally of low risk to wetlands, and can provide good protection. However, silvicultural activities can significantly affect groundwater recharge rates and impact on wetland water levels. The State Forest 65 pine plantations at Gnangara are attributed with causing a significant reduction in recharge below natural levels in areas not subjected to periodic thinning to meet target basal densities set to achieve groundwater management objectives.

4.3 Step 4

Table 6 provides a guideline for the identification of threatening processes associated with different land use categories. Relevant threatening processes should be identified through the assessment of possible impacts from applicable land uses. Once these have been identified for each wetland attribute, proceed to step 5.

Table 6: Summary of lands uses and associated threats Land Use

	Key Threatening Process			
Land use	**Alteration to the water regime**	**Habitat modification**	**Inappropriate recreational use**	**Diminished water quality**
Broadacre rural	• Land clearing and watertable rise with drowning of vegetation • Drainage to minimise flooding	• Loss of vegetation • Introduction of exotic flora and fauna • Overgrazing • Loss of fringing vegetation and erosion from stock trampling	• Power boating on larger water bodies in remote areas	• Pesticides and fertilisers • Salinisation
Intensive rural	• Land clearing and watertable rise with drowning of vegetation • Drainage to minimise flooding • Groundwater abstraction lowering water levels • Drainage into wetland	• Loss of vegetation • Introduction of exotic flora and fauna • Loss of fringing vegetation and erosion from stock trampling	• Horse riding trails associated with rural lifestyle living	• Pesticides and fertilisers • Nutrients from intensive animal industries • Some risk of organic and inorganic contamination form rural lifestyle living
Urban/ Residential	• Watertable rise through reduced rainfall interception and higher induced recharge • Use as drainage compensating basis • Groundwater abstraction lowering water levels • Reduced drying because of loss of aesthetic value of water body	• Loss of fringing vegetation to provide aesthetic views • Encroachment to achieve maximum commercial returns • Uncontrolled access trails affect vegetation • Traffic noise • Weed infestation • Feral and domestic animals	• High population pressures • Rubbish disposal	• Stormwater and drainage discharges carrying nutrients and inorganic and organic pollutants
Industrial	• Watertable rise through reduced rainfall interception and higher induced recharge • Groundwater abstraction lowering groundwater levels • Drainage into wetland	• Encroachment to achieve maximum commercial returns • Noise impacts		• Stormwater and drainage discharges carrying nutrients and inorganic and organic pollutants • Industrial pollutants
Other	Silvicultural activities affect rainfall recharge to groundwater		• Bank erosion • Noise and other disturbances • Water pollution • Vegetation trampling • Introduction of feral animals	

(Source: Welker Environmental Consultancy, 2002)

Application note 5: Identify role of separation

The wetland function area often will require additional separation from surrounding land use to ensure its protection and compatibility with the surrounding land use. Separation can involve two general forms: a physical barrier (fence, wall), or a spatial, along-the-ground separation distance or area. These forms are not mutually exclusive, and in some cases, a combination can provide a solution. Key considerations in defining separation needs are the attributes of the wetland and the threats associated with the surrounding land uses.

5.1 Separation

Separation (spatial separation and barrier separation) has a broad role in achieving and protecting the range of values associated with the management category and objective of any particular wetland.

Separation provides the following functions: (Bowen, Froend & O'Neil, 2002)

- reduces unchannelised accelerated water runoff from surrounding land;
- provides a physical barrier to slow surface flows and mechanically trap sediment and debris and chemically trap nutrients, salt and other contaminants;
- provides shelter in wind erosion prone areas;
- provides a native fauna corridor;
- provides screening between conflicting landscapes and/or disruptive movement and/or noise and/or approaching visitors;
- reduces the impacts of browsing animals;
- reduces the effects of nuisance insects; and
- prevents invasion of unwanted plants; and provide aesthetic value.

A vegetated separation area performs the following tasks in addition to those above:

- maintains water quality by filtering nutrients and trapping sediments;
- provides food, shelter and breeding habitat for terrestrial and aquatic fauna;
- provides shade to lower water temperature and increase oxygen holding capability of water body;
- provides shade to reduce nuisance aquatic plants and algae;
- provides energy source from debris from overhanging vegetation;
- provides food source for larger organisms where invertebrates living in vegetation are blown into the water and;
- reduces flood and salinity risk by increasing evapotranspiration;
- stabilises banks against erosion; and
- contributes to the tannin content of the water body reducing light penetration and consequently reducing incidence and severity of algal blooms. Colouring of water also can assist aquatic animals to hide from predators.

Areas of vegetation and grass also are recommended to be used where overland flow is the predominant medium for water input to wetlands[7]. This is because:

- vegetated areas can significantly slow overland flow into wetlands, and thereby prevent polluted water, sediment and nutrients from reaching the wetland and reducing erosive capacity; and
- grassed areas are very effective in reducing overland flow and mechanically trapping sediments and debris as well as nutrients (5 m wide grassed areas have been shown to remove about 70 per cent of sediment and 90 per cent of nutrients from run-off while an 8 m wide area removed up to 80 per cent of sediments and a 9.1 m wide strip removed from 96 per cent to 99.9 per cent of nutrients)[8]. However grassed areas run the risk of causing weed invasion into the wetland or adding nutrients if excessive fertilisers are applied or lawn clippings escape into the wetland. Consideration should be given to using appropriate non-seeding grass species to reduce the risk of seed flowing into the wetland.

There is increasing recognition that disease vector and nuisance insects such as midges and mosquitoes can affect urban residential areas close to wetlands. It is acknowledged that risk of impacts from disease vector and nuisance insects needs to be considered in certain land planning decisions. Midges and mosquitoes generally are controlled by chemicals, the use of water sensitive design and/or the use of buffers. Memorials on Title also are used to raise the awareness of the issue with potential homebuyers in areas affected severely by mosquitoes.

This issue is beyond the scope of this guideline, as it is a whole-of-government issue that requires a consistent approach across the State. The issue of disease vector and nuisance insects is addressed in greater detail from a planning perspective in Development of a Planning Policy for Mosquitoes and Development (DPI, 2001).

5.1.1 Separation distance and separation area

A separation distance is generally measured from the boundary of the wetland function area; however, may be measured from the boundary of the water body in cases of a permanent or seasonally inundated wetland with low ecological values.

The spatial form of separation can be considered as being a required setback or separation distance. The terms separation distance and separation area (figure 1) are used in this guideline as the term setback carries specific connotations that do not fit

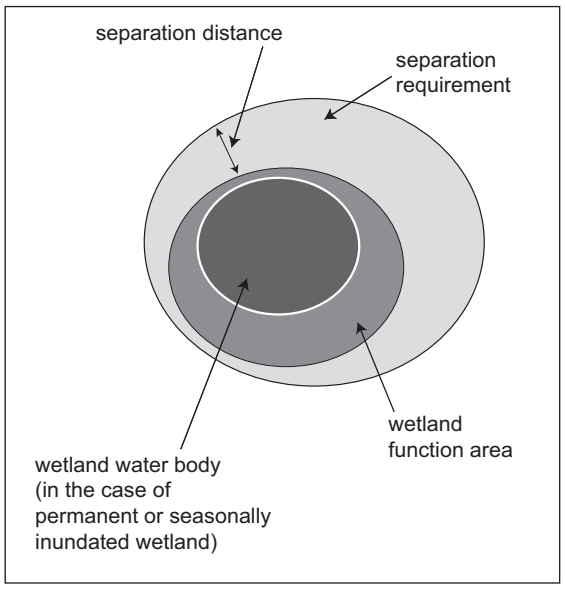

Figure 1 - Generalised wetland buffering concept (Welker Environmental Consultancy, 2002) (repeated)

[7] Overland flow is a minor contributor to wetland water in areas such as the Swan Coastal Plain where sandy or other permeable soils allow high levels of infiltration and natural water input to wetlands predominantly is through the underlying groundwater.

[8] Grassed areas must be grown without the use of excess fertilisers that can increase nutrient input to wetlands.

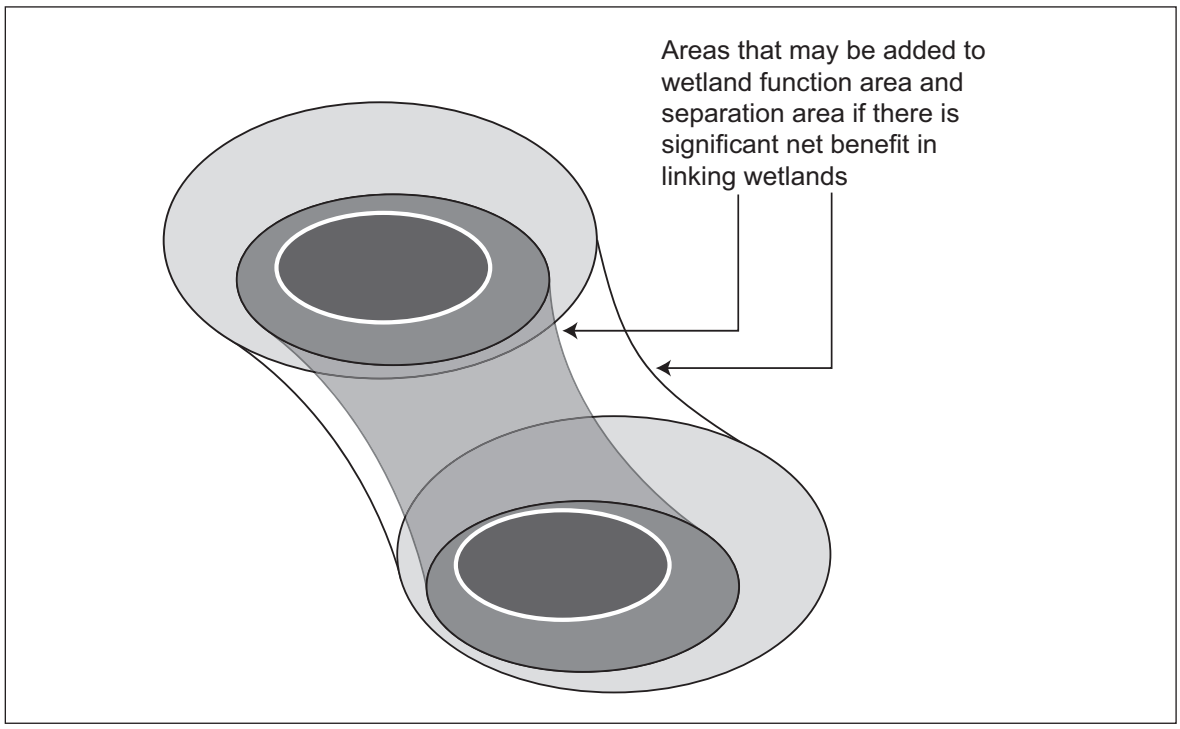

Figure 3 - Linking wetlands (Welker Environmental Consultancy, 2002)

with allowing and managing activities in separation areas. Additionally, use of the word zone also is avoided due to its specific planning meaning.

Figure 3 shows how the approach might be applied where two wetland function areas are in proximity and the wetlands can be linked. In this example, the wetland function area and separation distance for each wetland has been dealt with individually. Where the two wetlands are separate and in proximity (as shown) or where wetland function ares overlap, there may be an overall benefit in linking them, at least in terms of the separation distances, and in some cases, the wetland function areas, to provide a wetland corridor.

This approach would be appropriate in the situation of wetland suites and regional parks, where the benefit of linking the wetlands is determined, on balance, to outweigh the disadvantages of prohibiting activities within the increased separation area and wetland function areas.

5.1.2 Physical barriers

In some circumstances, physical barriers may provide an alternative to large separation area in certain circumstances, eg the use of a fence to keep domestic animals from nearby residences out of the wetland function area, or use of a path to help prevent spread of seed. To achieve the above through a separation distance would require a considerably larger separation area. In addition, more intensive management arrangements may be required.

5.2 Separation requirement

The separation requirement effectively is the envelope of the separation distance and management required to deal with all separation issues (eg habitat protection, fire management, water quality management) specific to each proposed or existing adjacent land use.

Activities compatible with the surrounding land use and the management objective of the wetland may be permitted in all or part of the separation area (eg passive recreation) in accordance with the wetland management plan.

The separation of wetlands from incompatible land uses helps to manage activities that cannot be controlled or managed by regulatory agencies. However, wetland buffers should also be supplemented by catchment management activities, especially where they provide a more practical means of achieving the desired aim than spatial separation.

5.3 Step 5

It is important to identify the role of separation as it relates to the individual wetland attributes to reduce the impacts of the adjacent land uses on the wetland (and vice versa). This will help to assess the ability of the achievable separation requirement to meet the wetland's management objective (Step 7) and provide the context for recommendations for management of the separation area.

For example, if one of the critical wetland attributes is that it is a migratory bird habitat and breeding ground protected under JAMBA and CAMBA, the role of the separation requirement is to protect the wetland function area from direct disturbance or other changes/impacts. This role is vital to the maintenance of the wetland's values and functions and must be assured through determination of the final separation requirement.

Table 7 sets out the role of separation in the mitigation of threatening process(es) relevant to associated adjacent land use. This table should be used to identify the role of separation in accordance with the threatening process(es) that would be expected to apply.

When the role of the separation measures in mitigation of potential impacts (threatening processes) with regard to adjacent land use(s) for each wetland attribute has been determined, proceed to Step 6.

Table 7: Role of separation to address threatening processes

Threatening process	Role of separation
Alteration to the water regime	• Reduces rates of surface (unchannelised) and subsurface inflow and therefore reduces potential for elevated levels and prolonged flooding • Resists channelisation, thus decreasing erosion and rate of water flow • Increases interception and evapotranspiration, reducing excessive flooding • Assists in adjustments to changing water levels via the expansion and contraction of plant communities • Vegetated wetland fringes may affect the water regime through increasing evapotranspiration losses from the groundwater system supporting the wetland
Habitat modification	• Vegetated buffers are valuable in minimising disturbance to the wetland and reducing potential for colonisation by exotic species • Fencing the perimeter of the buffer is effective in preventing access to the wetland by exotic terrestrial vertebrate fauna • Adds to and maintains wildlife habitat of a wetland • Firebreaks reduce potential for increased frequency of fire
Inappropriate recreational use	• Vegetated buffers can be used to enhance the aesthetics of a wetland, encouraging people to use that wetland rather than those of high conservation value • Provides barrier to visual and noise pollution • Minimises public access and activities in certain areas and/or wetlands
Diminished water quality	• Vegetated buffers assist in the reduction of nutrient inputs to wetlands through increased uptake and assimilation of surface and subsurface water-borne nutrients • Reduces un-channelised surface water flow rates, allowing suspended material to settle prior to wetland entry • Provides for management of drainage inputs (see Alteration to the water regime) • Avoids eutrophic conditions in a wetland and reduces the dispersal and impact of midges on surrounding areas • Hydrogeology within the catchment and immediately around and beneath the wetland has a significant influence on the effectiveness of a buffer with respect to water quality. The intensity of production of contaminants by the source is a major factor to be considered and managed

(Welker Environmental Consultancy 2002)

Application note 6: Establish separation requirement

The recommended separation requirements outlined in this guideline are determined by the likely impacts of adjacent land uses on the wetland and its values. Requirements are different for each management category because different separation measures are required to achieve the different objectives associated with each management category. The critical wetland attributes provide additional context for decisions on separation and management measures.

Recommended separation distances are given as ranges for several measures, in particular for firebreaks, aesthetic improvements, and nutrient and sediment control. In a case-by-case assessment, the distance should be determined by taking into account the physical characteristics relevant to the wetland, including wetland values and attributes, the surrounding land use and the feature being mitigated for or against (threatening process).

The rationale for selection of a separation distance should be justified in terms of the wetland's site-specific characteristics. For example, with firebreaks, the distance is dependent largely upon the vegetation (height, flammability), susceptibility of the wetland to fire effects, and the risk posed by and/or to surrounding land use. Aesthetic improvements and barrier controls are dependent on the characteristics of the surrounding land use. Noise control is governed by the characteristics of the potential noise generator. In the case of control of sediment and nutrient inputs through overland flow, the influential parameters are soil characteristics, slope of the land, vegetation cover (particularly in terms of its ability to retard flow and trap or take up containments), and potential contamination concentrations.

The buffering requirements in this guideline have been determined generally on the basis of management objective. Achievement of the management objective may require more than the proposed distance, or may be able to be achieved with less. Variation from the suggested distances needs to be considered on the merits of each case.

The recommended separation and management to mitigate potential impacts (threatening processes) for category C, R and M wetlands is shown in tables 8, 9 and 10 respectively. To help identify attributes that have high importance relative to the achievement of the aims of each management category, attributes shown in table 7 are listed.

6.1 Category C wetlands

Attributes identified as having high importance relative to achievement of the aims of the conservation (C category) management category are:

Ecological

- presence of rare, endangered, restricted, endemic or vulnerable species and/or communities;
- supports high habitat diversity;
- important for maintaining species and/or ecological diversity;

	• supports extensive areas of emergent and fringing wetland vegetation; • water quantity and quality; and • drainage (to and from the wetland) and presence of nutrient sources.
Other criteria	• rare or unusual wetland within a region; • Australian heritage commission criteria – important for natural or cultural history (4 separate criteria); and • unaltered or unusual wetland vegetation, fauna or processes.
Human use	• aesthetics; • wilderness function; • research resource/scientific importance; and • educational significance.

Recommended separation and management to mitigate potential impacts (threatening processes) for category C wetlands is shown in table 8.

6.2 Category R wetlands

Attributes identified as having high importance to achieve the aims of the resource enhancement (R category) management category are:

Ecological	• important regional wildlife sanctuary even if flora/ fauna are not rare or endangered
Other criteria	• important to maintain the quality of human or animal and plant life eg vegetation to arrest soil erosion

Table 8: Category C wetlands: Separation and management

Key threatening process	Recommended Separation and/or management	Separation area management
Alteration to the water regime	Regulation of groundwater abstraction as catchment management measure	• Area to be vegetated with deep-rooted perennial vegetation • Preferably native plant communities • 6m firebreak minimum, inside of fence • Fence to limit vehicle, stock, exotic fauna access • Clear perimeter outside of fence (path, firebreak, road. • Fire control to maintain habitat and species diversity • Minimise track access/clearing, maximise native vegetation • Management for water quality outcomes as required
Habitat modification	• 100 m weed infestation • Up to 100 m for bird habitat dependent on extent of use • 6-50 m firebreak • Fence for controlling exotic fauna access • ≥100 m to minimise edge effects	
Inappropriate recreational use	• ≥ 50 m to improve aesthetics • ≥ 50 m for barrier • Fence, paths for controlling access	
Diminished water quality	• Drainage inflows eliminated or managed • Where a proposal may affect wetland water quality, particularly through un-channelised flow, detailed site specific work should be undertaken to determine the specific separation measures required, including management measures	

(Source: Welker Environmental Consultancy, 2002)

Human use
- aesthetics
- passive recreation
- research resource/ scientific importance
- educational significance

R category wetlands can possess similar attributes to C category wetlands but the wetland may not be in as good condition or possess as many attributes. The attributes of C category wetlands therefore should be used as a guide.

Recommended separation and management to mitigate potential impacts (threatening processes) for Category R wetlands are shown in table 9.

6.3 Category M wetlands

Attributes identified as having high importance relative to achievement of the aims of the multiple use (M category) management category are:

Other Criteria
- important to maintain the quality of human or animal and plant life eg vegetation to arrest soil erosion, management of water quantity and water quality

Human Use
- passive recreation research resource/scientific importance
- educational significance
- important productive area for commercial endeavours eg fisheries

Recommended separation distances and management to mitigate potential impacts (threatening processes) for M category wetlands are shown in table 10.

Table 9: Category R wetlands: Separation and management

Key threatening process	Recommended Separation and/or management	Separation area management
Alteration to the water regime	Regulation of groundwater abstraction as catchment management measure	• Area to be vegetated with deep-rooted perennial vegetation. Limited open areas of grass • Controlled access to wetland (paths) • 6 m firebreak minimum, inside fence (if required) • Fence to limit vehicle, stock access • Clear perimeter outside fence (path, road) • Fire control to minimise hazards and maintain habitat diversity • Management for water quality outcomes as required
Habitat modification	• 50 m weed infestation • 50 m avifauna habitat • 6 m firebreak	
Inappropriate recreational use	• 10 m - 50 m for improving aesthetics • 10 m - 50 m for barrier • Fence, paths for controlling access	
Diminished water quality	• Drainage inflows eliminated or managed • Where a proposal may affect wetland water quality, particularity through un-channelised flow, detailed site-specific work should be undertaken to determine the specific separation measures required, including management measures	

(Source: Welker Environmental Consultancy, 2002)

It is acknowledged that M category wetlands generally are quite degraded, containing limited or no upland vegetation not infested with weeds, most likely resulting from uncontrolled access by humans or animals. There often is limited acknowledgement of the existence of the wetland and therefore inadequate management has occurred. Accordingly, it is not anticipated that many M category wetlands will require provision of a buffer between the wetland and the surrounding land use. The objective in these instances is restoration of the wetland and enhancement of wetland values where possible.

6.4 Step 6

Tables 8, 9 and 10 set out, by wetland management category, the separation and management recommended to mitigate the key threatening processes associated with the critical wetland attributes. These tables should be used to identify an appropriate separation distance and recommend management based on the key threatening processes identified in step 4 and the management category of the wetland.

The rationale for determination of a separation distance should be justified in terms of the site-specific characteristics. The separation requirement should be relevant to the critical wetland attributes as they relate to the key threatening processes and the individual characteristics of the wetland.

Separation distances and management measures are recommended on the basis of potential threats in order to mitigate likely impacts of the surrounding land use. Separation measures are required to mitigate only those threats that are present. For example, if there is no potential for loss of vegetation (habitat modification), there is no need for a separation requirement to manage this impact. Similarly, if the only threat identified is the potential for alteration to the water regime, no separation distance is required.

Table 10: Category M wetlands: Separation and management

Key threatening process	Recommended Separation and/or management	Separation area management
Alteration to the water regime	Regulation of groundwater abstraction as catchment management measure	• Area to be vegetated with deep-rooted perennial vegetation. Limited open areas of grass • Controlled access to wetland (paths) • 6 m firebreak minimum, inside fence (if required) • Fence to limit vehicle, stock access • Clear perimeter outside fence (path, road) • Fire control to minimise hazards and maintain habitat diversity • Management for water quality outcomes as required
Habitat modification	• 50 m weed infestation • 50 m avifauna habitat • 6 m firebreak	
Inappropriate recreational use	• 10 m - 50 m for improving aesthetics • 10 m - 50 m for barrier	
Diminished water quality	• Drainage inflows eliminated or managed • Where a proposal may affect wetland water quality, particularity through un-channelised flow, detailed site-specific work should be undertaken to determine the specific separation measures required, including management measures	

(Source: Welker Environmental Consultancy, 2002)

Generic separation measures are recommended in the tables. It is therefore necessary to ensure that the separation identified is relevant to the attribute associated with the threat.

The identification of an accurate separation distance for firebreaks, aesthetic improvements, and nutrient and sediment control, which are recommended as ranges in the tables, also is necessary. These distances should be determined by taking into account the physical characteristics relevant to the values and attributes of the wetland, the surrounding land use and the feature being mitigated for or against. This assessment is likely to require the services of a suitably qualified environmental professional.

When the appropriate separation requirement is established, proceed to step 7.

Application note 7: Apply separation requirement to proposal and assess ability of separation to achieve management objective

7.1 Step 7

This step involves the overlay of the separation requirement on the proposal to assess whether the recommended separation measures can be achieved. An aerial photograph should be used for this step. An overlay of clear film, which shows the proposal, cadastral boundaries, contours to identify ridgelines and extrapolate areas of wetland vegetation, and other land use planning information, may be more useful than marking the photograph. The wetland function area also should be drawn on the overlay. The required separation distance then can be measured from the boundary of the wetland function area.

7.2 Separation measures achievable

If the required separation measures are achievable, ie the separation distance can be achieved and recommended management measures implemented, proceed with the proposal.

7.3 Separation measures unachievable

In a practical situation, existing land planning decisions often make securing required buffering distances or necessary associated management regimes impractical. Effectively this means the wetland management category objective is not practically achievable without modification of existing decisions or the proposal of arrangements to ensure retention and maintenance of wetland values and attributes.

A simple example is where significant residential development has already been allowed to develop within the recommended separation distance. The residential land use is likely to compromise the function of the wetland and thus the achievement of the management objectives of the wetland.[9]

Figure 4 provides an indicative example of where previous land planning decisions have reduced the separation to an extent that is not adequate to provide the necessary separation. Within the area to the top of the diagram, the separation distance can be applied to its desired extent, but it is inhibited throughout the lower part of the diagram because of previous land planning decisions allowing encroachment of incompatible land uses.

[9] If development exists within the wetland function area, this should have been identified in step 2 and a wetland re-evaluation undertaken at that stage.

Because the desired separation area has been compromised by existing development, this may mean the values of the wetland function area potentially are compromised unless proved otherwise. However, as the desired separation is still able to be achieved around a significant part of the wetland function area, additional work could be done that may demonstrate that the wetland will still be able to maintain its management category objective.

In figure 4, the area at the top of the diagram also contains land with high conservation value that extends beyond what is necessary for separation. This area would be dealt with, in terms of setting it aside or putting a managed land use in place, on its merits. It should not be dealt with in the context of wetland buffering as it lies outside the area that by definition is required for achievement of the wetland's management objective.

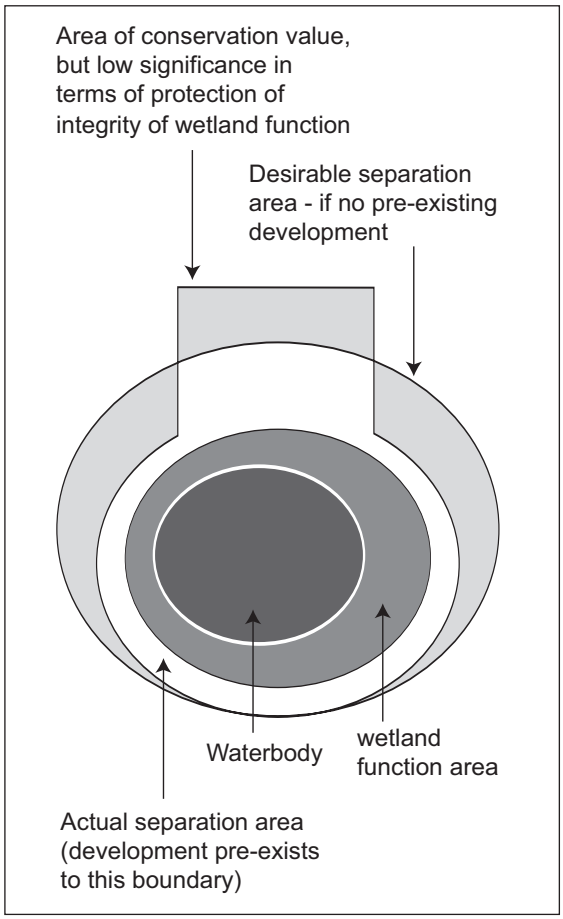

Figure 4 - Separation distance not able to be achieved (Welker Environmental Consultancy, 2002) (repeated)

If the required separation is unachievable, ie the recommended separation distance cannot be achieved around the whole wetland function area or the recommended management measures are unable to be implemented, an assessment of what is achievable is required.

7.3.1 C category wetlands

In the case of C category wetlands, a reduction in the required separation distance or management is unlikely to meet the conservation category management objective. If the boundary of the wetland could be compromised, the proposal should be referred to the EPA.

A case may still be made for reducing the recommended separation for a C category wetland. The argument should be substantiated by up-to-date technical information and evidence. Consultation with the DoE Wetlands Program is required.

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Every effort should be made to maximise the achievable buffer and implement improved management measures. This may include modification of the proposal where possible. If a proposal is unable to achieve the recommended separation, referral to the EPA is required.

7.3.2 R and M category wetlands

Small reductions in the recommended separation for R and M category wetlands, provided the reduction is not associated directly with the critical wetland attributes and additional management measures are proposed to address the reduction, may meet the appropriate wetland management objective.

7.4 Establishing an alternative separation requirement

In certain circumstances, it may be desired to create an outcome for the wetland that is significantly different from the current state of the wetland. Possible reasons for wishing to modify the current state include:

- inability to avoid or adequately manage impacts from adjacent land use as a result of the inability to achieve the required separation that protects current values;
- inability to maintain the current wetland function area which would result in an impact on current values;
- desire to enable development to encroach on the wetland function area or its separation because the overall net benefit of the development is extremely high and impacts cannot be avoided or adequately managed; and
- desire to improve the current values of the wetland by enhancing its features.

A landowner might have defined the required separation to maintain current attributes consistent with the management category but found the distance to be unachievable. An alternative separation then should be proposed, together with additional management measures that maximise the potential for the buffer to achieve the management objectives of the wetland. If there is scope to modify the proposal to achieve this, it should be done.

The alternative separation then should be evaluated for its ability to achieve the wetland's management objective.

7.5 Does the alternative separation meet the wetland's management objective?

The wetland management category and corresponding objective provides an obvious context for management. The difficulty is in understanding what the management objective means.

In the majority of cases for C category wetlands, current values should be maintained and therefore proposals that reduce the separation requirement are unlikely to be acceptable.

In the case of R and M category wetlands, current values should be maintained or enhanced where possible. The proposal must ensure the future outcome for the wetland is equal to, or preferably better than, what exists. It must be demonstrated that the potential impacts from the proposal will not result in a reduction in the existing values, attributes or condition of the wetland. If the separation is unachievable, additional management must be proposed to reduce the impacts from the proposal to the point where the existing condition of the wetland is enhanced, or at least, preserved. Table 11 outlines the management priorities for the three categories of wetlands. This provides the context for the desired future outcome of the wetland.

7.6 Making a case for an alternative separation requirement

Consultation with the DoE Wetlands Program and the DPI Environment and Natural Resource Management Branch should occur at this time.

The proposed separation should be justified in terms of the wetland attributes it is desired to achieve and protect, and by implication, its actual or expected future state as defined by its objective. The identification of attributes associated with the wetland management category, and whether the protection of those current attributes can be achieved, forms the basis for justification of an alternative separation requirement. The case must be substantiated with up-to-date technical information, presented in a logical format.

The argument for reducing the separation requirement should be based on consideration of the overall balance of social, environmental and economic aspects associated with the various parameters that may affect the future of a wetland. The original wetland evaluation will provide information regarding some of the social considerations affecting the wetland. Economic considerations also are relevant, including the cost of ongoing management and maintenance and who is responsible for this funding.

Stakeholder involvement in the decision-making process is a requirement on public land, where the role of various regulators and responsibility for decision-making also needs to be considered. Community consultation should occur where it is known that there is a community interest in the current use and future outcome of the wetland.

Table 11: Wetland management categories, objectives and management priorities

Category	Description	Objective	Management priorities
Conservation (C category) wetlands	Wetlands which support high levels of attributes and functions	to preserve wetland (natural) attributes and functions	Preserve wetland attributes and functions through reservation in national parks, Crown land and protection under environmental protection policies
Resource Enhancement (R category) wetlands	Wetlands which have been partly modified but still support substantial functions and attributes	to restore wetlands through maintenance and enhancement of wetland functions and attributes	Restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in Crown reserves, State or local government land and by environmental protection policies, or in private property by sustainable management
Multiple Use (M category) wetlands	Wetlands with few attributes which still provide important wetland functions	to use, develop and manage wetlands in the context of water, town and environmental planning	Consider use, development and management in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare

(Source: Hill et al, 1996).

If, after addressing the management of likely impacts from the proposal, it can be demonstrated that the wetland's management objective is able to be met, proceed with the proposal.

Where the proposed separation and management, if implemented, may result in a change to the wetland values or attributes, appropriate environmental approvals may be required to enable such an impact on the wetland. In these instances, it is recommended that consultation occur with the DoE, to identify an approach that will result in acceptable environmental outcomes. The WAPC may be unlikely to approve a proposal that is not supported by the DoE. For R and M category wetlands, a negotiated outcome will need to be achieved in consultation with the DoE. For C category wetlands, if it cannot be demonstrated that the wetland values and attributes will be enhanced or maintained, and the proposal cannot be modified to ensure this outcome, the proposal should be referred to the EPA.

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Websites:
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Appendix 2: Definitions

AHD	Australian Height Datum.
anthropogenic	affected by or related to humans.
benthic	relating to or living in or on the bed of a body of water including the silt or mud that lies there.
bio-diversity	variety of life forms: different plants, animals and micro-organisms, genes they contain, ecological functions they perform and ecosystems they form. It is usually considered at three levels: ecosystem diversity, species diversity, and genetic diversity.
buffer	separation of a wetland from adjacent land use through either spatial separation or the use of physical barriers to reduce the threats to desired values and attributes and ensure wetland activities do not have undue impact on the land use.
CALM	Department for Conservation and Land Management.
conservation	management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is the positive, embracing, preservation, maintenance, sustainable utilisation, restoration and enhancement of the natural environment.
creek	type of wetland, a seasonally inundated channel (Semeniuk, 1987).
dampland	type of wetland, a seasonally waterlogged (damp) basin of variable size and shape (Semeniuk, 1987).
directly associated dependent terrestrial vegetation	vegetation that occurs in association with a particular wetland. Also referred to as wetland vegetation.
DoE	Department of Environment.
DPI	Department for Planning and Infrastructure.
ecosystem	defined community of organisms, their interaction, and their physical surroundings (Department of Environment, Sport & Territories (1994). State of the Environment reporting: Framework for Australia. 42pp, Canberra, ACT).
environmental value	beneficial use or an ecosystem health condition (ie, a condition of the ecosystem relevant to the maintenance of ecological structure, ecological function or ecological process).
ecological integrity	physical, chemical and biological components of an ecosystem and the interactions between those components, being in a sound, undiminished and unimpaired state.
EPA	Environmental Protection Authority.

EPP	environmental protection policy.
evapotranspiration	the transfer of water into the atmosphere through evaporation from the land and transpiration from plants and animals and can be calculated from the difference between precipitation and the amount of run-off.
floodplain	type of wetland, a seasonally inundated flat (Semeniuk, 1987).
inter-generational equity	principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
lake	type of wetland, a permanently inundated basin of variable size and shape (Semeniuk, 1987).
palusplain	type of wetland, a seasonally waterlogged flat (Semeniuk, 1987).
paluslope	type of wetland, a seasonally waterlogged slope (Hill et al, 1996).
river	type of wetland, a permanently inundated channel (Semeniuk, 1987).
separation area	area between the boundary of the wetland function area and the outer limit of the separation requirement that extends as far as the separation distance.
separation requirement	furthest extent of the separation distances required to deal with all separation issues (eg, habitat protection, fire management, water quality management) specific to each particular proposed or existing adjacent land use.
silviculture	the science and economics of the establishment, management, composition and growth of forests.
sumpland	type of wetland, a seasonally inundated basin of variable size and shape (Semeniuk, 1987).
upland vegetation	vegetation that exists outside the wetland function area.
WALIS	Western Australian Land Information Service.
WAPC	Western Australian Planning Commission.
wetland attribute	characteristic or combination of characteristics which is valued by a group within society, but which does not necessarily provide a function or support a use.
wetland characteristic	properties of a wetland which describe the area in the simplest and most objective possible terms (e.g. wetland size, species present, soil type, water quality). Characteristics, singly or in combination, give rise to benefits (existing or future) which may be functions, uses, or attributes of a wetland.
wetland function area	area required to be protected to ensure the important functions and values of the wetland can be maintained.

wetland function	aspect of a wetland that, potentially or actually, supports or protects a human activity or human property without being used directly.
wetland value	measure or expression of worth placed by society on a particular function, use or attribute.
wetland vegetation	vegetation which is adapted to inundated or waterlogged conditions that often forms overlapping zones along an elevational gradient from the deepest part of a wetland. Wetland vegetation is essential to the ecological functioning of a wetland (and includes fringing and riparian vegetation) (Balla, 1994)
wetland water body	part of a wetland where there is an expression of open water.
WRC	Water and Rivers Commission (now the DoE).

Appendix 3: Example of application of the guideline - Lake Yangebup

Figure 5: Yangebup Lake (Source: Former Department of Land Administration StreetExpress Directory, 2000)

Step 1 Acknowledge existence of wetland

Yangebup Lake is located on North Lake Road and can be identified on the Geomorphic Wetlands Swan Coastal Plain dataset (DoE) as unique feature identifier number 6602.

Step 2 Identify wetland attributes, wetland management category and establish management objectives

Has a wetland management category been assigned?

Yes. Yangebup Lake is a conservation category wetland.

Are existing wetland values, processes, functions and attributes consistent with the assigned management category?

Yes. Yangebup Lake is a first-tier recognised wetland. It is on the Interim List of the Register of the National Estate, protected by the *Environment Protection Biodiversity Conservation Act 1999* as it provides a location for JAMBA/CAMBA species. It is protected under the Swan Coastal Plain Lakes EPP (EPA 1992) and located within Bush Forever Site 256) (Government of WA, 2000b). It also is reserved for Parks and Recreation and managed by the Department of Conservation and Land Management (CALM) as part of Beeliar Regional Park.

The review of the justification for the high management category identified the following key values, processes and attributes for Yangebup Lake:

(a) high habitat diversity and wide representation of ecological communities (including upland communities);

(b) part of regional conservation/wildlife park;

(c) part of significant regional wetland system;

(d) part of regionally significant contiguous bushland/wetland linkage and wildlife corridor (Greenways 78 and 81);

(e) supports wetland fringing vegetation;

(f) recognised migratory bird (as protected under JAMBA/CAMBA) habitat/breeding ground;

(g) important permanent water body for ducks (second highest recording of some species of 300 wetlands surveyed);

(h) supports a wide range of macroinvertebrate fauna;

(i) provides habitat and/or refuge for a range of frogs, reptiles (including the long-necked tortoise), birds and mammals that would not be there if a wetland was not present;

(j) significance to Aboriginal culture;

(k) entered on the Interim List of the Register of the National Estate;

(l) visual amenity of open water; and

(m) maintaining processes essential for retaining wilderness condition, which contributes to its landscape value.

The key attributes critical to the conservation category management objective of "to preserve wetland (natural) attributes and functions" are points (a), (e), (f), (g), (i) and (j). These are the attributes that are critical to the determination of the extent of the boundary of the wetland function area and the appropriate separation requirement.

The lake also retains nutrients from a nearby wool-scouring settling pond, performing a filtration function for local groundwater. This attribute is in conflict with the wetland's high conservation status and the CALM management objective.

The information sources used to identify the above attributes include the justification for protection of the area as a Bush Forever Site and the draft Beeliar Regional Park Management Plan (CALM, 2001) which identifies important attributes to be protected.

Step 3 Define wetland function area

Where practicable, the wetland function area is the area required to support the attributes of the wetland (see table 12). In the case of Yangebup Lake, the wetland function area should contain at least the entirety of wetland vegetation plus all remnant upland vegetation communities abutting the wetland vegetation in Bush Forever site 256, to ensure the maintenance of all ecological communities associated with the wetland. Remnant vegetation areas within the Bush Forever site separated from the wetland vegetation by completely degraded areas (>50 m wide) containing no native species are excluded from the wetland function area as they are effectively isolated from the wetland and also are not part of a wetland-upland continuum associated with the wetland.

As Yangebup Lake is part of a regional wetland system and due to the close proximity of a wetland both to the north and south of the lake, the wetland function area practically extends to link with wetland function areas of these two wetlands, Little Rush Lake and The Kogalups (North and South Kogalup Lake). The definition of the wetland function area boundary to assess setbacks from Yangebup Lake is relevant to only the west and east of the lake. The presence of developed residential and industrial land immediately west and east of the Bush Forever site boundary means the wetland function area does not extend further in these directions outside that boundary.

If the areas to the west and east of the lake were not developed, the wetland function area would extend to a limit defined by the average range of dependent fauna associated with the wetland (attribute (i)). The lake is inhabited by long-necked tortoises, which are known to move from the wetland to lay eggs. Typically they roam between 50 and 200 m, but have been known to move as far as 500 m, from water bodies (WRC 2000, Bamford pers. comm. 2002).

The wetland function area therefore should extend at least 200 m from the wetland vegetation around Yangebup Lake, as this is an ecological requirement of a species dependent on the lake. This would be the case for any conservation category wetland that supports long-necked tortoises under this framework. However, because of the existing residential and industrial development around Lake Yangebup, the wetland function area

cannot be realised. The wetland function area reaches its optimum extent in some areas, but for the most part, is restricted by pre-existing development. The wetland function area therefore corresponds to the wetland entity as mapped by Hill et al. 1996 (see Figure 5).

Table 12: Requirements to support significant attributes of Yangebup Lake

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
High habitat diversity and wide representation of ecological communities (including upland communities)	Maintain representation of all identified ecological communities associated with wetland, to include upland communities abutting wetland vegetation zone	All remnant vegetation within Bush Forever site boundary abutting wetland vegetation in continuum. (excludes completely degraded areas and vegetation beyond them)	• Habitat modification	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Part of regional conservation/ wildlife park	Support attributes consistent with management objectives	N/A	• Alteration to the water regime • Habitat modification • Inappropriate recreational use • Diminished water quality	As above
Part of significant regional wetland system	Maintain wetland area	Boundary of wetland as mapped Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification	• Can link adjacent wetland separation areas • Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg external origin of resources)
Part of regionally significant contiguous bushland/ wetland linkage and wildlife corridor (Greenways 78 and 81)	Maintain bushland links north, south and east of wetland	Providing connection with bushland to north, south, and east	• Habitat modification	As above

Table 12: Requirements to support significant attributes of Yangebup Lake (continued)

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Supports wetland fringing vegetation	Maintain areas containing emergent wetland species	Boundary of wetland as mapped Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area) through hydrological and terrestrial processes (eg. external origin of resources)
Recognised migratory bird (protected under JAMBA/ CAMBA) habitat/ breeding ground	Maintain areas of open water, seasonally inundated areas used for breeding and other areas of vegetation likely to be used by species	Boundary of wetland as mapped by Hill et al (1996) plus surrounding vegetated areas known to be used by birds	• Alteration to the water regime • Habitat modification • Inappropriate recreational use	As above
Important permanent water body for ducks (second highest recording of some species of 300 wetlands surveyed)	Maintain areas of open water, seasonally inundated areas used for breeding and other areas of vegetation likely to be used by species	Boundary of wetland as mapped by Geomorphic Wetland Swan Coastal Plain Dataset (DoE) plus surrounding vegetated areas known to be used by birds	• Alteration to the water regime • Habitat modification • Inappropriate recreational use	As above
Supports a wide range of macroinvertebrate fauna	Maintain natural water level	Areas permanently or seasonally inundated	• Alteration to the water regime • Habitat modification • Diminished water quality	As above
Potentially provides habitat and/or refuge for a range of frogs, reptiles (including tortoise), birds, and mammals, that would not otherwise be there if a wetland was not present (associated fauna)	Maintain all areas on which associated fauna are dependent, such that local representation is not affected. Long-necked tortoise is assumed to require greatest distance from wetland (200 m) (see text)	Extending from wetland to average known extent of foraging/ use of associated fauna	• Alteration to the water regime • Habitat modification • Inappropriate recreational use • Diminished water quality	As above

Table 12: Requirements to support significant attributes of Yangebup Lake (continued)

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Significance to Aboriginal culture	Maintain natural state of wetland, particularly area of inundation	Boundary of wetland as mapped by Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification	• Can add to as well as maintain features of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area • Protection of wetland features and function integral to cultural values • Protection from direct disturbance or other change/impact to the wetland function area
Entered on the interim list of the Register of National estate	All of above	Bush Forever site boundary	• Alteration to the water regime • Habitat modification • Inappropriate recreational use • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
Visual amenity of open water	Maintain accepted water levels	Areas permanently or seasonally inundated	• Alteration to the water regime	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area
Maintaining processes essential to retain wilderness condition, which contributes to its landscape value	All of above	Wetland function area (as defined from amassing areas described above)	• Alteration to the water regime • Habitat modification • Inappropriate recreational use • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
Filtering for wool-scouring settling pond effluent moving into groundwater – lake serves to retain nutrients and buffer effect on local groundwater	Ensure rate of effluent flow to wetland does not exceed ability of wetland to filter out contaminants from groundwater (filtering function of wetland will decrease water quality and is likely to affect natural other natural attributes)	Area within groundwater catchment zone of wool-scouring settling ponds	• Alteration to the water regime • Diminished water quality	• Vegetation interception and use of water in surface and subsurface flow • Can suppress watertables locally • Role highly dependent on hydrogeology and catchment characteristics • Role redundant where piped discharge into wetland occurs

(Source: Welker Environmental Consultancy, 2002).

Step 4 Identify threatening processes

The threatening processes for each attribute were considered and are listed in table 12 above. Processes that potentially could threaten the significant attributes of this wetland were identified based on consideration of the environmental risks of the surrounding parks and recreation reserve and residential and industrial land uses. Table 6 was used to aid this assessment. The presence of three drains discharging directly into the wetland is a key consideration in managing wetland water quality.

The threatening processes requiring separation and/or management for Yangebup Lake are:

- alteration to the water regime;
- habitat modification;
- inappropriate recreational use; and
- diminished water quality.

Step 5 Identify role of separation

The role of separation (ie distance and management) for each attribute was identified based on consideration of tables 4 and 7. The role of separation for each attribute is listed in table 12.

Step 6 Establish separation requirement

The recommended separation distances for this management category are outlined in table 8.

The following separation measures (ie. distance and management) should be implemented for Yangebup Lake to maintain condition consistent with its management objective:

- 100 m from wetland function area to urban and park areas to prevent weed infestation;
- Provision of 6 m to 50 m firebreak at and within separation requirement. (Note: DoE is unlikely to support firebreaks that need to be placed within the separation area if it requires significant clearing of native vegetation);
- ≥100 m from wetland function area to urban area to minimise edge effects;
- ≥ 50 m from wetland function area to urban area to improve aesthetics and barrier from inappropriate recreational activities;
- 20 m to 100 m to prevent surface flow of suspended solids; and
- drainage inflows eliminated or managed.

A separation distance of at least 100 m from the wetland function area would be recommended to meet the wetland's management objective, together with elimination or management of drainage inputs.

Other wetlands are located close to Lake Yangebup and the linking of separation areas and wetland functions also could be considered.

Step 7 Apply separation requirement to proposal and assess ability of separation to achieve management objective

Existing development, which has prevented the desired wetland function area being realised, will prevent a suitable separation distance and management measures from being implemented to support the management category objective. Both the wetland function area and the separation distance are inconsistent with the management category objective and the consequence of this lack of adequate buffering has been long term degradation of the lake and loss of conservation value. Any proposal for development within the separation requirement is unlikely to be acceptable and should be referred to the EPA.

Appendix 4: Example of application of the guideline - South Lake

Figure 6: South Lake (Source: Former Department of Land Administration StreetExpress Directory, 2000)

Step 1 Acknowledge existence of wetland

South Lake is located south and west of North Lake Road, Bibra Lake, in the City of Cockburn and can be identified on the Geomorphic Wetlands Swan Coastal Plain dataset (DoE) as unique feature identifier numbers 6603 and 6605.

Step 2 Identify wetland attributes, wetland management category and establish management objectives

Has a Wetland Management Category been assigned?

Yes. South Lake is a resource enhancement category wetland.

Are existing wetland values, processes, functions and attributes consistent with the assigned management category?

The lake is located in Beeliar Regional Park, manged by CALM and is identified as Bush Forever site 254. South Lake is an EPP lake and is part of System 6 area M93. It is entered in the Interim List of the Register of the National Estate and therefore subject to protection under the *Federal Environment Protection and Biodiversity Conservation Act 1999*.

South Lake is a small, shallow, permanent lake covered extensively by reed beds. It is surrounded by a diversity of dense vegetation which provides a habitat for a wide variety of birds. In the open water, aquatic plants attract large wading birds. The lake is a popular bird feeding area and is used by large numbers of migratory waterbirds. The lake is likely to serve a role as a breeding habitat for waterbirds because of the presence of fringing vegetation such as rushes, sedges and paperbarks.

The area is reserved for parks and recreation. The lake is surrounded by paperbark/ banksia woodland and is in good to very good condition, although there are some areas of severe localised disturbance.

Step 3 Define the wetland function area

Where practicable, the wetland function area is the area required to support the attributes of the wetland (table 13).

The South Lake wetland function area should incorporate all wetland vegetation plus all remnant upland vegetation bordering the wetland vegetation, to ensure the maintenance of all ecological communities associated with the wetland. Remnant vegetation areas separated from the wetland vegetation by degraded areas (>50 m wide) are excluded from the wetland function area as they are effectively isolated from the wetland and are not part of a wetland-upland continuum associated with the wetland.

At its furthest point, the wetland function area extends over 300 m from the water body on the eastern side of the lake. The vegetation on the western side is more disturbed and degraded, leaving a wetland function area of about 40 m from the water body. Although upland vegetation in good condition adjoins the degraded area to the south-west, the wetland function area does not continue into this area as it is separate from the functioning of the wetland. This does not mean the vegetation does not possess conservation values in its own right; however.

It could be argued that the wetland function area be extended to connect with a smaller wetland directly north. This wetland; however, is separated from South Lake by North Lake Road, which comprises a road and cleared road reserve of 50m wide. This distance is considered enough of a separation that the wetland function areas would not be contiguous; however, the buffer areas of the wetlands would overlap.

Table 13: Requirements to support significant attributes of South Lake

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
High habitat diversity and representation of ecological communities (including upland communities)	Maintain representation of all identified ecological communities associated with wetland, to include upland communities abutting wetland vegetation zone	All remnant vegetation within Bush Forever site boundary abutting wetland vegetation in continuum. (excludes completely degraded areas and vegetation beyond them)	• Habitat modification	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Part of regional conservation/ wildlife park	Support attributes consistent with management objectives	N/A	• All	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Part of significant regional wetland system	Maintain wetland area	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification	• Can link adjacent wetland separation areas • Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Supports wetland fringing vegetation	Maintain areas containing emergent wetland species	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Waterbird habitat/breeding ground	Maintain areas of open water, seasonally inundated areas used for breeding and other areas of vegetation likely to be used by species	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset (DoE) plus surrounding vegetated areas known to be used by birds	• Habitat modification • Alteration to the water regime • Inappropriate recreational use	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Supports a wide range of macroinvertebrate fauna	Maintain natural water level	Areas permanently or seasonally inundated	• Alteration to the water regime • Habitat modification • Diminished water quality	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna

Table 13: Requirements to support significant attributes of South Lake (repeated)

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Provides habitat and/or refuge for a range of frogs, reptiles, birds, and mammals, that would not otherwise be there if a wetland was not present (Associated fauna)	Maintain all areas on which associated fauna are dependent, such that local representation is not affected. This is assumed to include contiguous upland vegetation	Extending out from wetland to average known extent of foraging/utilisation of associated fauna	• All	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Significance to Aboriginal culture	Maintain natural state of wetland, particularly area of inundation	Boundary of wetland as mapped in the Geomorphic Wetland Swan Coastal Plain Dataset (DoE)	• Alteration to the water regime • Habitat modification	• Can add to as well as maintain features of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area • Protection of wetland features and function integral to cultural values
Entered on the Interim List of the Register of the National Estate	All of above	Bush Forever site boundary	• All	• Protection from direct disturbance or other change/impact to the wetland function area • Reduces potential for colonisation by exotic species and introduction of exotic terrestrial fauna
Visual amenity of open water	Maintain accepted water levels	Areas permanently or seasonally inundated	• Alteration to the water regime	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area

Step 4 Identify threatening processes

The threatening processes for each attribute were considered and are listed in table 13. Processes that could potentially threaten the significant attributes of this wetland were identified based on consideration of the environmental risks of the industrial zoned land to the south and west, the urban land to the east and the surrounding parks and recreation reserve which is separated by the other regional roads reserve. Table 6 was used to aid this assessment.

The threatening processes requiring separation and management for South Lake are:

- alteration to the water regime;
- habitat modification;
- inappropriate recreational use; and
- diminished water quality.

Step 5 Identify role of separation

The role of separation (distance and/or management) for each attribute was identified based on consideration of tables 4 and 7. The role of separation for each attribute is also listed in table 13.

Step 6 Establish separation requirement

The recommended separation for this management category is outlined in Table 9.

The following separation measures (distance and/or management) should be implemented for South Lake to maintain a condition consistent with its management objective:

- regulation of groundwater abstraction as catchment management measure;
- 50 m from wetland function area to industrial and urban areas to prevent weed infestation;
- 50 m in addition to the wetland function area to protect bird habitat; provision of 6 m to 50 m firebreak at edge of separation requirement;
- ≥ 50 m from wetland function area to industrial and urban areas to minimise edge effects;
- ≥ 50 m from wetland function area to urban area to improve aesthetics and barrier from inappropriate recreational activities;
- 20 m to 100 m to prevent surface flow of suspended solids; and
- ensuring no drainage inflows from nearby industrial or residential areas.

A maximum separation distance of 100 m from the wetland function area is required to meet the wetland's management objective and to minimse impacts on the wetland associated largely with the proposed industrial area to the south.

Other wetlands are located close to South Lake and the linking of separation areas and wetland functions should be considered in the context of any further development in the area.

Step 7 Apply separation requirement to proposal and assess ability of separation to achieve management objective

A buffer of 100 m from the boundary of the wetland function area can be achieved to the south and east of South Lake, as the land is part of Bush Forever site 254 and reserved for parks and recreation. Although the wetland water body directly abuts industrial zoned land to the west, the proposed subdivision of this land (Lot 502) by LandCorp intends to include a buffer of at least 150 m from the water body. As the vegetation on this side is less than 50 m wide, this proposed buffer should be sufficient to retain wetland function.

The only questionable area is to the north, where a section of the buffer contains North Lake Road. As the area adjacent is reserved for parks and recreation, it is considered that although the road may be a barrier to large fauna movement, this is not seen as critical to the maintenance of the significant functions of the wetland. Accordingly, the imposition of a 100 m buffer around South Lake can be achieved and will meet the management objective of the wetland.

Appendix 5 Example of application of the guideline - Stillwater Gardens Lake

Figure 7: Stillwater Gardens Lake Source: Former Department of Land Administration StreetExpress 2000)

Step 1 Acknowledge existence of wetland

Stillwater Gardens Lake is located on Berrigan and South Lake Drives and can be identified on the Geomorphic Wetlands Swan Coastal Plain dataset (DoE) as unique feature identifier number 6523.

Step 2 Identify wetland attributes, wetland management category and establish management objective

Has a Wetland Management Category been assigned?

Yes. Stillwater Gardens Lake is a multiple use category wetland.

Are existing wetland values, processes, functions and attributes consistent with the assigned management category?

Yes. The lake is located in open parkland in the suburb of South Lake and categorised for multiple use as described by Hill et al (1996). It is under the management of the City of Cockburn and is not considered to possess any significant conservation values (City of Cockburn, pers. comm. 2002). It is zoned urban and is not protected. The lake is surrounded by reticulated grassed parkland used for recreational activities such as walking, jogging, picnics etc.

The lake represents a surface expression of the groundwater table in a low lying area and is likely to act as a local discharge area and help to maintain low groundwater levels in surrounding residential areas. Some stormwater drainage from surrounding roads is diverted to the lake and hence the lake has some function for local drainage.

As the lake is a permanent open body of water, however small, it is likely that some duck species frequent the lake. The lake is unlikely to serve any role as breeding habitat for waterbirds because of the absence of fringing vegetation such as rushes/sedges/ paperbarks. The lake is not considered to support any significant flora or fauna values.

Step 3 Define the wetland function area

The wetland function area of Stillwater Gardens Lake is defined by the area within the high water level mark for the wetland as determined from the requirements for significant attributes (table 14).

Step 4 Identify threatening processes

Processes that potentially could threaten the attributes of this wetland were identified based on consideration of the environmental risks of the surrounding urban zoning and near by parks and recreation reserve. Table 6 was used to aid this assessment.

The threatening processes for each attribute were considered (table 13). The relevant attributes identified are:

- alteration to the water regime
- diminished water quality

Table 14: Requirements to support significant attributes of Stillwater Gardens Lake

Attribute	Requirement to support attribute, for the purpose of defining the wetland function area	Definable boundary/extent	Key threatening processes	Role of separation
Frequented by duck and possibly other waterbird species	Maintain natural water level	Areas permanently or seasonally inundated	• Alteration to the water regime	• Protection from direct disturbance or other change/impact to the wetland function area • Can provide indirect support for wetland function area through hydrological and terrestrial processes (eg external origin of resources)
Visual amenity of open water	Maintain seasonal water level	Areas seasonally inundated	• Alteration to the water regime	• Can add to as well as maintain aesthetics of wetland function area • Protection from direct disturbance or other change/impact to the wetland function area
Local drainage	Access and sufficient basin size to prevent flooding of surrounding area	Dependent on amount of water to be received	• Alteration to the water regime	• No role

Step 5 Identify role of separation

The role of separation for each attribute was identified based on consideration of tables 6 and 7. The role of separation for each attribute is listed in table 14.

Step 6 Establish separation requirement

The recommended separation (distances and/or management) for this management category are outlined in table 10.

However, as no separation is required to manage the potential for alteration to the water regime, no separation area beyond the wetland function area is required. Proposals for appropriate development outside the wetland function area of the wetland should meet the management objective for a multiple use wetland.

Water quality and groundwater abstractions in the catchment will still need to be managed; however, to ensure no impact on the values, functions and attributes of the wetland.

Other wetlands are located close to Stillwater Gardens Lake. The potential to link the separation areas and wetland function areas could be considered.

Public submissions for the draft Guideline for the Determination of Wetland Buffer Requirements

This has been released to seek public comment on the information in the draft guideline. All aspects of the guideline will be re-assessed prior to being finalised.

Every submission received will be acknowledged in writing and will be considered in the review process. All submissions will be treated in the strictest confidence.

When making a submission, it is very helpful to:

- clearly state your opinion and the reasons for your opinion
- if possible, outline possible alternatives or solutions to your area of interest
- if possible, include the section or page number which relates to your area of interest
- provide any additional information to support your comments.

A public submission form is included overleaf for your convenience, which can be posted free of charge. If you prefer to make a comment in an alternative format, please remember to include the relevant details as outlined on the submission form.

The closing date for submissions is Friday 14 April 2006

You can send your submissions free of charge to:

Guideline for the Determination of Wetland Buffer Requirements
Western Australian Planning Commission
Albert Facey House
469 Wellington Street
Reply Paid 80014
PERTH WA 6000

If you would like more information on making a submission, please contact:

Manager environmental planning,
Tel: (08) 9264 7777
Fax (08) 9264 7566
email: corporate@wapc.wa.gov.au

We look forward to receiving your submission.

Public submission form

Draft Guideline for the Determination of Wetland Buffer Requirements

1 Name: .....

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2 Organisation (if relevant): .....

3 Address: .....

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4. Interest: .....

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(eg local resident, business operator)

I/we would like to make the following comments on the draft Guideline for the Determination of Wetland Buffer Requirements and would like them to be considered in the preparation of the final document

Comments: .....

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